STUDY-TOUR REPORT ON THE GROWING OF
FIBRE FLAX AND KENAF IN EGYPT
(APRIL-MAY 1967)

Ir. J.C. Friederich

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I. INTRODUCTION

At the request of the Government of the UAR, I, Johan Coenraad Frie-
derich, consultant for fibre crops with the Ministry of Agriculture in
Holland, have carried out during the period from 9th April 1967 to 4th May
1967 an investigation in the UAR into the possibilities of increasing the
profitability of growing and processing flax (kettan) and kenaf (teel).
As agriculture plays an important role in the second Economic Development
Plan, which has been extended to seven years (1965-1972), the main target
was to study the possibilities of increasing the place of flax and kenaf
in the total output value of agricultural and industrial production. During
the investigation the following three subjects and their related details
were also closely studied for flax and kenaf, i.e.:
1. the potentialities in the UAR for growing flax and kenaf
2. the possibilities to increase the yield and quality of flax as it is
grown in the UAR
3. possible improvement of the existing processing methods as carried out
   in the different mills, that have been visited.
Obviously, the time available was insufficient to carry out an intensive
investigation into all aspects of above three subjects, which, in order to
arrive at a more solidly based opinion, would have had to have been
thoroughly considered.
Therefore, I have had to confine myself to a rough study of these as-
pcts through my own observation and with the aid of many details kindly
made available to me from several sources and especially from the director
and staff of the Fibre Crops Research Station at Giza.
Furthermore, the investigation concerned only the Delta in Lower Egypt
and the Giza province in Upper Egypt, where far back into history, since
3100 B.C., farmers have gained experience with the growing, retting and
processing of flax and kenaf for local consumption, though kenaf has been
only introduced as a new crop on a larger scale some years ago.
Finally, it was not considered advisable or justifiable to introduce
the current Dutch methods of flax cultivation, and the experience of gro-
wing kenaf in Indonesia just before the World-War II, based on the results
of research over many years, until well planned and reliable experiments
have been carried out on the spot to compare these methods, with the exis-
ting methods of flax and kenaf growing in the UAR.
In this regard, the actual situation for flax and hemp on the world
market, the considerable differences in climatic (rainfall and daylight)
and soil conditions between the UAR and Holland speak for themselves, and
these factors have been seriously taken into account when compiling this
report.
II. RESULTS OF THE INVESTIGATION ON FLAX
(local name = kettan)

1. The potentialities in Egypt for flax growing

The area under flax cultivation has actually declined to about 26000 feddans, which is about 50 percent of the area grown in 1941-1942 during the World War II. So it can be said that there will be sufficient feddans available to enlarge the area to be grown with flax. However the farmer must be willing to grow flax, which depends on the financial returns comparing favourably with those from cereals and other crops, especially while the growing of flax demands more careful attention and much more labour than growing cereals. Further the return which the farmer can get for flax straw depends on the demand of the local market and particularly of the export potentialities of long fibre and tow on the world market. Actually the world market prices for long fibre and tow are at a low level due to the surplus of long fibre and tow on the world market and to the French subvention system for dew retted long fibre and tow. Because of the protectionist policy in France (a governmental subvention for growing and processing flax of nearly 320 Dutch guilders (33 E.L) per hectare, a low rate of interest on credits, lower wages and land rent and tax payment facilities) and well advanced mechanization in dew retting the cost of processing dew retted flax in France is about 7 cents (1 pt.) per kg straw. Because of this France has changed from being a flax fibre importing country to a flax fibre exporting one. France is now growing a higher percentage of flax than is permitted under the gentlemen’s agreement made at Naples.

Table la. GRADUATION SAMPLES OF EGYPTIAN LONG-FIBRE ACCORDING DUTCH STANDARDIZATION

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Quality</th>
<th>Remarks (organoleptic valuation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3½</td>
<td>weak</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>not uniform in strength</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>too coarse and black spots of rust infection</td>
</tr>
<tr>
<td>4</td>
<td>3½</td>
<td>meagre and weak</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>too coarse</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>too short else 3; slightly too hard</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td>too short else 5;</td>
</tr>
<tr>
<td>8</td>
<td>5½</td>
<td>slightly coarse</td>
</tr>
<tr>
<td>9</td>
<td>4</td>
<td>too coarse</td>
</tr>
<tr>
<td>10</td>
<td>3½</td>
<td>feeling too hard in the grip</td>
</tr>
<tr>
<td>11</td>
<td>5</td>
<td>slightly too coarse</td>
</tr>
<tr>
<td>12</td>
<td>5</td>
<td>coarse and hard</td>
</tr>
<tr>
<td>13</td>
<td>3</td>
<td>idem</td>
</tr>
<tr>
<td>14</td>
<td>5</td>
<td>too short else 6; rather soft</td>
</tr>
<tr>
<td>15</td>
<td>4½</td>
<td>coarse and hard</td>
</tr>
<tr>
<td>16</td>
<td>5</td>
<td>too coarse</td>
</tr>
<tr>
<td>Giza-4</td>
<td>4½</td>
<td>slightly too coarse and therefore slightly too hard</td>
</tr>
</tbody>
</table>

2 = very bad quality
5 = medium quality
7 and more = good quality (fine, soft, waxy and strong).

Table lb. ANALYSIS OF SAMPLES OF EGYPTIAN STRAW RETTED AND SCUTCHED AT THE FLAX-LABORATORY IN WAGENINGEN

<table>
<thead>
<tr>
<th></th>
<th>Giza 4 (Foundation)</th>
<th>Giza 4 (Registered)</th>
<th>Dutch standard '67 Reins</th>
</tr>
</thead>
<tbody>
<tr>
<td>length</td>
<td>95-100 cm - coarse</td>
<td>75 cm - rather coarse</td>
<td>78</td>
</tr>
<tr>
<td>long-fibre</td>
<td>15.85 %</td>
<td>15.4 %</td>
<td>23.1 %</td>
</tr>
<tr>
<td>low</td>
<td>7.1 %</td>
<td>6 %</td>
<td>1.7 %</td>
</tr>
<tr>
<td>total fibre</td>
<td>22.95 %</td>
<td>21.4 %</td>
<td>24.8 %</td>
</tr>
<tr>
<td>fibra quality</td>
<td>2</td>
<td>3</td>
<td>9</td>
</tr>
</tbody>
</table>
Graph 1. Hours of daylight in Holland and Egypt
Moreover, the average fibre quality of Egyptian flax, in consequence of the incorrect growing and poor processing of the straw and due to the variety Giza-4, grown for dual purposes (production of fibre and seed as well), is rather low and of medium-grade (see Table 1). These disadvantages have first to be overcome before the flax mills can pay a price for the flax straw at such a level that the farmers will be interested in growing flax.

Actually, the industry has great difficulties in getting farmers to grow flax, because a flax crop demands more care from the farmer than a wheat crop. However, there is one big advantage, the Egyptian farmer has his experience in growing flax by historical tradition. But it is imperative to increase the return to the grower relative to the return on wheat by educating the farmer in improving the methods of growing and handling of the straw and if possible by continuing tariff protection on linseed oil.

In the next Table 2 a calculation of the financial returns of wheat and flax has been made, according to the figures given by the responsible people of the Research Station.

Table 2. FINANCIAL RETURN FOR THE FARMER GROWING WHEAT AND FLAX

<table>
<thead>
<tr>
<th>Crop</th>
<th>Average yield per feddan</th>
<th>Average unit price</th>
<th>Income per feddan</th>
<th>Production costs</th>
<th>Net income p. feddan</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>straw kentar ardab</td>
<td>straw peasters</td>
<td>straw seed E.£</td>
<td>straw seed E.£</td>
<td>in E.£</td>
</tr>
<tr>
<td>Wheat</td>
<td>7.30</td>
<td>101</td>
<td>6.69</td>
<td>31.24</td>
<td>15.17</td>
</tr>
<tr>
<td>Flax</td>
<td>53</td>
<td>3.38</td>
<td>27.03</td>
<td>49.98</td>
<td>17.12</td>
</tr>
</tbody>
</table>

Though the net profit for flax per feddan is about 10 E.£ higher than for wheat, experience in practice has shown that the differences in net profit are not big enough to make the farmer willing to grow flax. However, by improving his method of growing flax he can get a higher yield of straw and seed of a better quality. Increasing the production and quality of straw and seed per feddan could result in a still better financial return to the grower. Moreover, the farmer has to be educated to grow flax not only for his own profit but also to the benefit of the national income and to provide the mills with sufficient raw material.

According to the standards in Holland i.e. 6000 kilos of deseeded straw and 1000 kilos of seed and based on the premium of the Egyptian Government of 14.5 E.£ per ton deseeded straw and 75 E.£ per ton of seed the farmer can get a net profit per feddan of 2520 x 1.45 pt. + 420 x 7.5 pt. - 17.12 E.£ = 36.54 E.£ + 31.50 E.£ - 17.12 E.£ = 50.92 E.£. The measures to be taken to achieve higher yields of deseeded straw and seed per feddan and a higher and better fibre quality will be discussed under Chapter 2.

As to the weather conditions in Egypt they vary substantially from those in Holland (see Tables 3 and Graph 1). The rainfall in Holland appears to be more evenly spread and totals 292 mms in the five months of flax growing, far higher than the total of 21-155 mms in Egypt. However, the advantages for Egypt are the possibility of irrigation when the flax needs water during its development and the dry harvesting month, where there is no risk for damage to the fully ripened flax straw by heavy rainfalls as in Holland. Also, the day temperatures on the average are higher in Egypt especially in the beginning of the growing season and the humidity percentage is lower.
Table 3. WEATHER CONDITIONS IN THE FLAX GROWING AREAS OF EGYPT
(normals for Giza and Alexandria)

<table>
<thead>
<tr>
<th>Area</th>
<th>Month</th>
<th>Temperature °C</th>
<th>Relative Humidity %</th>
<th>Rainfall (mm)</th>
<th>Daylength</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean daily max.</td>
<td>Mean daily min.</td>
<td>Mean of day</td>
<td>No. of Days with at least 0,1 mm</td>
</tr>
<tr>
<td>Giza</td>
<td>January</td>
<td>18,5</td>
<td>10,6</td>
<td>13,7</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td>February</td>
<td>19,1</td>
<td>11,0</td>
<td>14,1</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>March</td>
<td>22,2</td>
<td>12,8</td>
<td>15,8</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>April</td>
<td>23,5</td>
<td>15,0</td>
<td>18,1</td>
<td>69</td>
</tr>
<tr>
<td>Alex.</td>
<td>May</td>
<td>26,2</td>
<td>18,0</td>
<td>21,0</td>
<td>72</td>
</tr>
<tr>
<td></td>
<td>June</td>
<td>28,2</td>
<td>20,8</td>
<td>23,6</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td>July</td>
<td>29,7</td>
<td>23,0</td>
<td>25,4</td>
<td>77</td>
</tr>
<tr>
<td></td>
<td>August</td>
<td>30,4</td>
<td>23,6</td>
<td>26,2</td>
<td>75</td>
</tr>
</tbody>
</table>

Table 4. WEATHER CONDITIONS IN THE FLAX GROWING AREAS OF HOLLAND
(normals for Vlissingen and Groningen)

<table>
<thead>
<tr>
<th>Area</th>
<th>Month</th>
<th>Temperature °C</th>
<th>Relative Humidity %</th>
<th>Rainfall (mm)</th>
<th>Daylength</th>
<th>Hours of sunshine</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean daily max.</td>
<td>Mean daily min.</td>
<td>Mean of day</td>
<td>No. of Days more than 1 mm</td>
<td>Total</td>
</tr>
<tr>
<td>Vliss.</td>
<td>January</td>
<td>3,1</td>
<td>-0,1</td>
<td>2,9</td>
<td>87</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>February</td>
<td>3,1</td>
<td>3,1</td>
<td>5,1</td>
<td>85</td>
<td>-7</td>
</tr>
<tr>
<td></td>
<td>March</td>
<td>5,7</td>
<td>5,1</td>
<td>7,5</td>
<td>77</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>April</td>
<td>9,1</td>
<td>8,3</td>
<td>11,0</td>
<td>74</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>May</td>
<td>14,0</td>
<td>11,9</td>
<td>15,4</td>
<td>76</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>June</td>
<td>16,3</td>
<td>15,1</td>
<td>17,2</td>
<td>74</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>July</td>
<td>18,1</td>
<td>17,4</td>
<td>21,6</td>
<td>76</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>August</td>
<td>18,3</td>
<td>14,5</td>
<td>20,0</td>
<td>77</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>September</td>
<td>16,1</td>
<td>15,4</td>
<td>19,9</td>
<td>79</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>October</td>
<td>11,8</td>
<td>11,4</td>
<td>16,0</td>
<td>82</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>November</td>
<td>7,5</td>
<td>7,3</td>
<td>9,7</td>
<td>87</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>December</td>
<td>4,5</td>
<td>4,3</td>
<td>6,5</td>
<td>88</td>
<td>11</td>
</tr>
</tbody>
</table>

Gron. | January | 1,2 | -2,4 | 0,9 | 90 | 12 | 61 | 47 |
|      | February | 1,7 | 1,3 | 1,5 | 86 | 11 | 46 | 64 |
|      | March | 4,6 | 3,9 | 6,0 | 81 | 9 | 40 | 111 |
|      | April | 8,8 | 7,6 | 9,7 | 75 | 10 | 45 | 158 |
|      | May | 13,2 | 11,6 | 15,4 | 74 | 9 | 52 | 209 |
|      | June | 16,4 | 14,7 | 21,0 | 71 | 10 | 54 | 208 |
|      | July | 18,0 | 16,5 | 22,5 | 75 | 12 | 86 | 187 |
|      | August | 17,8 | 16,4 | 22,8 | 77 | 12 | 86 | 179 |
|      | September | 14,8 | 12,8 | 19,3 | 80 | 11 | 69 | 139 |
|      | October | 10,1 | 9,4 | 13,0 | 85 | 12 | 70 | 94 |
|      | November | 5,7 | 5,4 | 9,1 | 89 | 12 | 69 | 46 |
|      | December | 2,7 | 2,5 | 6,0 | 85 | 12 | 58 | 38 |

--- = months of flax growing

**Total**

<table>
<thead>
<tr>
<th>Vliss.</th>
<th>710</th>
<th>1629</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gron.</td>
<td>736</td>
<td>1480</td>
</tr>
</tbody>
</table>
Finally, in Holland the hours of daylight during the latter months of growing and maturing period appear to be considerably higher on the average than is the case in Egypt, which, however, is slightly compensated for by the lower light intensity in Holland. In contrast with kenaf or teel flax starts flowering at a daylight period longer than 12 hours or at temperatures above 18 degrees Celcius.

The alluvial soils in the Delta which are considered suitable for flax in the flax growing provinces of Egypt appear not to differ very strongly in their component parts from the flax soils in Holland (table 5), although the organic matter content is rather low. For the new reclaimed soils in the Northern-Tahrer province the soil analysis gives a rather high pH resulting from the high lime content, but nevertheless the soil seems suited to grow flax. In any case, the Delta soils are well drained and through sowing with berseem clover for crop rotation and through irrigations, the soils are sufficiently fertile to grow flax. Besides, the application of farm yard manure and fertilizers in the form of Nitrogen, Phosphate and Potash, when needed, can increase the fertility.

To continue, it can be stated that the goal of 45000 feddans of flax can easily be achieved with the climatic and soil conditions of Egypt. Only the financial return compared with those from other winter crops, such as cereals or beans is an obstacle; that and the lack of demand for flax fibre on the local market and the export possibilities on the world market.

Table 5. REQUIREMENTS OF SOIL AND SOIL ANALYSIS FOR GROWING FLAX

| FLAX NEEDS A CALCAROUS, WELL DRAINED, NOT TOO HEAVY CLAY OR SANDY CLAY SOIL |
|---|---|---|
| Analysis average | Flax soil in Holland | Analysis | Giza | Egyptian soils Tahreer province |
| pH KCl | 7 | % | 7.2 | 7.8 |
| total sand 16-90 | 55-65 | % | 60 | 46 |
| lutem | 25-45 | % | 25 | 17 |
| P-Al | 31-39 | % | 11 | 25 |
| CaO: (lime) | 16-21 | % | 12 | 26 |
| Organic matter (humic) | 2 | % | 1,15 | 33,8 |
| | 3 | % | 0,23 | 3,1 |

2. The possibilities to increase the yield and quality of flax as it is grown in the UAR

The growing of flax in Egypt is dictated by the aim to get a high yield of fibre and a high yield of seed as well. Therefore the straw will be pulled in a state of more full maturity than is usual in Western-Europe.

From the observation of the inspected flax crops the following conclusions can be drawn:

a. The straw on average has a good length and a nice colour but is not free of rust attack and of weeds
b. The earliest sown crops, on the whole, have the greatest length
c. Compared with the Dutch flax straw the straw is somewhat uneven in length, but especially uneven in thickness and is coarser
d. The impression was gained that most of the flax is harvested too late. Therefore, and on account of the higher temperatures and the continuing dryness at the ripening stage, the flax straw and flax fibre generally speaking is somewhat harsh and stiff in the grip (organoleptic valuation) and not as soft and waxy as in Holland.
Also inspected several times were the flax experimental plots and nursery trials at Giza Research Station and Sakha Agricultural Experiment Station, where several new crosses had been sown with a view to breeding new selections of rust resistant and productive varieties for the future. This breeding programme has been established on a large scale which makes a close examination of hybrids and strains rather complicated. For this purpose, all the new arrivals totalling more than 200 in number have been sown as a standard collection on small plots in rows. It would be more efficient to sow the arrivals and single plant selections as in Holland with the so-called "stove pipe" method. Also the collection has to be separated in three main groups of fibre flax, oil seed flax and types for dual purpose to prevent natural crossing and to be able to compare the different types and strains more exactly. This system allows the flax to grow under conditions more closely allied to those applicable to flax grown commercially, and for this reason a more reliable valuation and comparing of the variety-characteristics is possible. Also the soil conditions for a nursery trial have to be excellent, while this was not the fact at Giza, where the soil looks rather heavy and irregular. Moreover several plots have been attacked by flax diseases such as Rhizoctonia solani Kuhn and Fusarium oxysporum Schlecht. f.sp. lini (Bolley) Syrian & Hans. Later on, the F_3 and older generations can be sown on small plots (0.2 - 4 sq.m.) with a special sowing machine at a row spacing of 8 cm at a rate of 15 g seed per sq.m. (see FIBRA vol. 10 no 2/3, p. 73) to get the same density of plants (same number of plants per square metre). This is very important to check the differences in resistance to lodging and to compare the fibre content and fibre quality.

For testing the rust resistance, a very rust-susceptible variety, for instance Resistenta, has to be used as inoculator and sown in a long row along all the plots to be tested.

In considering which measures could be taken to achieve higher yields per feddan and a better fibre quality, in accordance with the experience in Western-Europe and after the observations made during visits to the flax fields and flax factories, the following factors could be taken in consideration.

3. Crop rotation

As flax is considered as a winter crop it can only be sown after a summer crop, if the harvest of the summer crop has been finished in time, that is to say before the first of November or after winter legumes where the land is left fallow for flax. Perhaps sometimes maize or rice may be also sown before flax as crop rotation. However flax is mostly grown after cotton and a normal crop rotation is cotton-flax-maize or rice - wheat - cotton (if sown before the end of March). It would be preferable to insert berseem as a crop in the rotation to improve the fertility of the soil. As in Holland for this reason, to contribute to the organic content of the soil, clovers are used as undersown crops in flax, it would be desirable to have also a try with this system in Egypt. However the Berseem has to be broadcast 20-23 days after the sowing of the flax to prevent a too vigorous development, which would have a detrimental effect on the flax.

4. Soil type and preparing of the seedbed

Flax requires a not too heavy, calcareous and well drained soil with, if possible, some percentage of organic matter left from a previous crop. Generally speaking a soil suitable for wheat will be also suitable for flax. Preparing the seedbed should aim at achieving a fine structure as level as possible without lumps and with sizes as big as possible having regard to
irrigation. This is to avoid the presence of too many ridges in the field, which cause uneven thickness of the flax stems. Usually the seed beds have an area of 2 times 4 = 8 till 4 times 10 = 40 square metres and are not carefully enough prepared, which makes the drilling by flax sowing machines quite impossible. Ploughing to, at most, 10 cm in depth and afterwards harrowing in two directions and, if necessary rolling with a light horse-roller to work up a fine tilth is recommended. These measures are one of the first requirements to ensure even germination and growth to arrive at an uniform quality of the straw.

5. Sowing seed

The use of good quality sowing seed of pure strain, free from seed borne parasites and weeds and of a good germination capacity is the most important factor towards the growing of a product of high yield and good quality. In Holland the General Netherlands Inspection Service for Seeds of Field Crops and for Seed Potatoes (NAK) guarantees the quality of the sowing seed through two inspections in the paddocks during flowering and strict supervision during the transport, storing, deseeding and cleaning, of the sowing seed and finally through sampling and sealing of each bag fit for resowing. In each bag there is a label giving all particulars such as origin, variety and class (original, 1st, 2nd, or older multiplication). On request the analysis of the sowing seed is made available by the Government Seed Testing Station. Of each parcel of sowing seed to be sold this Station receives for analysis an average sample, officially taken by representatives from the NAK. This system of compulsory control for all Dutch seed to be exported, is a guarantee for the quality. Potential sowing seed which does not meet with the established standards is rejected as sowing seed and will only be used in the oil factories.

In Egypt the breeder foundation and registered seed is produced at the Agricultural Experimental Stations under the responsibility of the Ministry of Agriculture. However the certified seed is produced by special farmers on contract. Though mostly (80%) the Giza-4-variety is grown in Egypt, also the older varieties Hindi and Baludi are still grown by the farmer. Moreover, the pulled flax is not rippled by machines or by special hand-combs but often beaten in bundles on a piece of stone. This gives a severe risk of mixing the variety and of threshing damage to the straw and seed. The breeder of any variety has to take care that his variety is kept pure and up to the mark and should build up his pedigree seed each year very carefully, which has to be multiplied as breeders foundation and registered seed and brought into circulation as certified seed for sowing by the farmer. In this regard, a close collaboration between the breeder and the seed inspection service would be strongly recommended. Although no faults have been found during by visits in the system of production of sowing seed, there are strong doubts whether, for the certified seed, sufficient attention is paid to the prevention of variety mixing and the necessary measures to get sowing seed of the highest quality. In my experience a rapid deterioration of high yielding and disease-resistant-varieties, obtained by devoting much time, care and money is not an impossibility.

6. Seed disinfection

Disinfection of the flax seed for resowing purposes, to control the seed borne parasites present on the seed, is compulsory in Holland. This is more or less considered as an insurance premium for the prevention of the transmission of diseases and the sudden appearance of possible new diseases. Though the weather-circumstances in Egypt are more favourable than in Holland
to get sowing seed free from seedborne parasites, the cost of disinfection of the sowing seed is very little. Also treating the sowing seed by liquid volatile mercury products as Abitlon or Penogen (3 cc per kg of seed) is a guarantee for a healthy start of the crop.

If the sowing seed is to be broadcast by hand, disinfection by the not poisonous TMTD-products is to be preferred.

7. Rate and Method of seeding

In Holland, drill sowing at a rate of 120–140 kilos/hectare of sowing seed, is general. The rate of sowing seed depends on the time of sowing and the quality of the soil. Early sowing and heavy soils ask for a higher rate of sowing seed. The use of special sowing machines as available in Holland (see photo 1 and 2 and appendix III), which can also be utilized for the sowing of cereals, peas and sugarbeets (by simply removing the tubes), and further the sowing of flax at 4 to a maximum of 10 cm row spacing and 2–3 cm deep, deserves close consideration if higher returns of a more uniform quality are to be obtained. These machines can be adjusted to sow accurately at any required seeding rate with a margin of 5 kilos either way.

In Egypt the seed is normally broadcast at a seeding rate of 60–75 kg per feddan (about 160 kg/ha) and afterwards, irrigation water is applied. It is an established fact based on experience, that broadcasting the seed calls for a higher rate and gives less uniform density than drilling the seed, especially as the seed lies on the soil and by careless irrigation may be swept into heaps. One or more trials to find out the possibilities of drilling the seed by sowing machines, if they can be adjusted according the normal sizes and ridges of the seedbeds in Egypt, would be of great value and of benefit to the flax growing in Egypt.

8. Undersown crops

As already mentioned under crop rotation item 1, the possibility of sowing undersown crops makes flax growing for the Dutch farmer more attractive. However, one is restricted to low growing types of clover such as white clover (Trifolium repens) and yellow trefoil (Medicago lupulina) or several low growing grasses, such as smooth stalked meadowgrass (Poa pratensis), red fescue (Festuca rubra) or creeping fescue for seed multiplication. High growing clovers as lucerne (Alfalfa) or red clover (Trifolium pratense) are normally sown 2–3 weeks after flax sowing to prevent damage to the flax crop. In the same way perhaps berseem (Trifolium alexandrinum) or higazy-clover (Medicago sativa) would be profitable under Egyptian conditions and should be considered.

9. Fertilizing

In practice the amount of fertilizers to be applied varies according to the fertility of the soil. In Egypt no fertilizer would be used after fallow preceded by legumes. In other rotations 5-15 m³/feddan (5-15 tons) farm yard manure should be applied just before ploughing the land. Also 100 to 150 kilograms nitrate of lime per feddan (250 kg/ha) can be applied and 100 kg/feddan of superphosphate (250 kg/ha) when needed.

It should be given in one application just before the first watering or in two just before the first and the second watering. The best fertilizer in Holland, if needed, is 100 to 200 kg/ha of nitrate of lime or lime ammonium nitrate, (15-40 units of Nitrogen per ha), applied at the time of sowing, and 400 kg/ha superphosphate and 300-400 kg/ha muriate of potash sown one month before seeding. But it should be noted that the nitrogen dressing has
1. Sowing of flax with harrowing afterwards

2. Row spacing 4 cm

3. After pulling, flax is kept in gails

4. Transport to the farm and storing the flax
to be limited to prevent lodging of the flax and attack of diseases which has a detrimental effect on the quality and often also on the yield of straw. Compound (NPK-fertilizers) are coming into the picture, but zinc or manganese because of deficiency are rare in Holland.

10. Control of Diseases and Pests

Complete control of diseases should be sought through the correct disinfection of the sowing seed and the breeding of disease resistant varieties. Possible pests such as flea-beetle, thrips and lucerne-fly can be completely controlled by spraying with dieldrin or parathion as soon as the first attacks have been observed. Early spraying in good time is the best control. Over larger areas aerial spraying is recommended as this is little more expensive but more quickly effective.

11. Variety-Research

Since rust attack can be one of the most serious problems in flax growing countries, only rust resistant varieties should be considered. As Giza-4 is not completely resistant to rust the new Dutch rust resistant varieties Fibra, Reina, Hera and Primo should be tried under Egyptian conditions. For this reason samples of seed have already been left at the Giza Research Station to test them as soon as possible in glasshouse experiments. Moreover Giza-4 is bred as a cross between Giza purple and Giza oil flax and cannot be approved of as a pure fibre flax variety. Though the yield of seed is very important in Egypt, the Dutch varieties can give a high yield of fibre and of seed as well. The fact that Holland annually exports 7000 tons of flax seed for sowing to all flax growing countries in the world proves the quality of the Dutch varieties. Possible participation in international variety research, in collaboration with some 14 other countries and organized centrally from Wageningen should be considered. The advantages for each of the participating countries, while acknowledging the rights of the breeders, when a particular variety is released for commercial growing, will already have been noticed. Since the beginning of this century quantities of sowing seed of several continental flax varieties have been imported each year into Egypt, but it would be advantageous to import quantities of sowing seed of the most productive rust-resistant varieties as soon as possible.

Finally the breeding programme, as being drawn up by Dr. Mokhtar and his collaborators, has been carried out with the object of improving the yield and quality of fibre in Egypt.

12. Weed Control

Although on field inspection only a few paddocks were crowded by weeds (Ipomoea ramoni (morning glory), Amaranthus spec., Lepidium sativa, Lolium rigidum and other kinds), chemical weed control would be profitable. In addition to post-emergence products such as MCPA, NaDNOC, and mixtures of both these products, pre-emergence products such as soil herbicides of butyron, lenacryl, triazine and linuron can be sprayed to give effective control. But weed control trials have first to be carried out to test the effectiveness on weeds and the possible damage to flax. And each lot of sowing seed, in which seeds of dangerous and noxious weeds appear, should be rejected to prevent spreading of these weeds.

13. Irrigation

Three irrigations are usually needed in addition to the first irrigation immediately after broadcasting the seed, i.e.:
1. after 25 days from sowing,
2. before flowering (about 20 days from the 1st irrigation),
3. after complete flowering (about 20 days from the 2nd irrigation).

Flax needs about 4\(^\frac{1}{2}\) to 5 months from sowing till full ripening. The irrigation should be done only if the flax plants are in obvious need of water, and has to be done carefully and uniformly. Too much water and too frequent irrigation give excessively vigorous growth of the flax which increases the risk of lodging and reduces the fibre content of the flax straw. Sometimes the last irrigation may have to be postponed to avoid too fast ripening of the flax.

14. Date of harvesting

As mentioned previously it would appear that generally speaking the flax crop in Egypt is pulled too late, which, next to the higher temperatures and the prolonged dryness during maturing, could also cause the flax fibre to be less flexible and of poor spinning quality.

If, in future, the crops are pulled somewhat earlier - in Holland pulling starts with the flax in the yellow-green stage, when the seed is not yet fully ripe - the flax should remain in gaits for three or at most five days (photo 3) and then stacked in heaps. Afterwards the flax straw can be transported from the fields to the barns by a tractor (see photo 4) or loaded on trucks for transport to the mills. Flax straw should not be exposed too long to the sun. Some harvesting time trials, whereby harvesting is done with intervals of 10 days and also the time in the gaits and stacks is adjusted accordingly, will indicate how far earlier harvesting can improve the fibre quality without losses in yield of seed.

15. Method of harvesting

In Egypt the flax is still pulled by hand. Though labour is not very expensive, pulling by hand can only be done by skilled labourers. In Europe the flax is pulled only by machines which is cheaper and much quicker, so the crop can be pulled at the right time. During the last five years flax pulling machines (see photo 5) have improved and give good results with regular tied sheaves and a high pulling capacity. The price of these machines, of which the self propelled "Depoortere" and "Union" (see photo 6) perform best, is approximately 2400 E.£ (appendix IV). These machines pull the flax from the front, carry it over the top of the machine in a binder and throw it out in a sheaf at the rear. The capacity is about 0,5 ha an hour, but it should be noted that the average speed should not be more than approximately 6 kilometers per hour. Otherwise the flax is tied carelessly and askew, causing much unnecessary loss when retted and scutched later on. Also lodged flax can be pulled, though with more difficulty; the small seedbeds and the ridges for irrigation however will call for special modification of these pulling machines for Egypt. There are also smaller and cheaper ones of about 1100 E.£., pulled by a tractor.

16. Rippling of the flax

Normally the flax in Egypt, after having been exposed to and dried in the sun, will be rippled and threshed by beating the sheaves of flax on a piece of stone. The result is disastrous for the straw and for the seed if meant for sowing seed. For the straw it results in a lot of waste straw, which produces only tow and decreases the long fibre content. For the sowing seed it gives a fair chance of threshing damage and mixing up with seed of flax plants of other varieties.
From experiences in Holland, it would be preferable to transport the undeseeded flax straw to a central place and to deseed it by a rippling/threshing seed cleaning machine. One of the best machines is "De Mooie Molen" from the Deman Construction firm in Belgium (see photo 7, appendix V). There are three types on full rubber tyres for open air use with a capacity of 2000 to 3000 kg per hour of undeseeded straw with a flax straw binding machine behind the rippling machine for binding the straw with two strings. The prices are approximately from 1100 E£ to 1800 E£ for the rippling and 440 E£ for the binding machine.

Purchase of these machines, which improve the quality of the straw and seed, would be strongly recommended.

17. Reasons for Crop Failures

Upon enquiry with various people, dealing with flax in Egypt, it appears that each year some paddocks have to be rejected on account of failure or bad quality. The following causes have been mentioned:

a. Lodging (either through too much nitrogen or sowing too heavily),
b. Too late sowing of the crop (length of straw very short),
c. Too much weed in the flax,
d. Very heavy rust attack,
e. Too late pulling of the crop.

The suggestions, already made in this report, should lead to a reduction of crop failures and an improvement of the quality. The potentialities as to soil and to experience and knowledge are certainly there. Training courses for farmers and labourers will be indispensable. The harvesting risk will be reduced, and fewer flax crops or parts thereof will be rejected for further processing or will be paid less, due to the bad quality.

However a certain number of experiments and a certain time for adjustment will be needed to achieve the best possible results. It should be particularly noted that the experience gained in Western Europe cannot be adopted in Egypt without further and careful research. A visit of some months by a member of the staff of the Giza fibre crop research station to the fibre research station in Wageningen, should be taken seriously in consideration.
III. POSSIBLE IMPROVEMENT OF THE EXISTING PROCESSING METHODS AS CARRIED OUT IN THE DIFFERENT FLAX MILLS THAT HAVE BEEN VISITED

Though not specialized on the processing, spinning and weaving of flax I made use of the opportunity of obtaining a rough impression of the production of long fibre, tow and linen yarns and ropes as it is carried out in the different flax- and spinning mills in Egypt.

a. Preparing the straw for retting

The farmer has to deliver the deseeded flax straw and flax seed to the mills and is, according to the instructions of the Government, not allowed to ret and scutch the flax himself. The flax straw, as delivered by the farmer, is on average of a poor quality and not bound in a proper way. More timely harvesting, not at the fully ripe stage, and more careful handling of the straw during rippling and binding of the sheaves in a more uniform way (greater evenness of the butt) would be an improvement for the latter process of retting and scutching. Paying for the flax straw not only according to the length but also according to the quality and proper handling, should be considered. Moreover, covering the flax straw in stacks in the open air with tarpaulins, will reduce the deterioration of the quality of the straw.

b. Retting system

The normal system of retting in Egypt is like that in Holland and Belgium - warm water- or tank retting. On the basis of the data given by staff of the flax mills, the sizes of the retting tank vary between 6 x 8 x 2,70 to 9 x 8 x 2,70 or 140 to 190 cubic meters. The construction is more or less based on the figures and informations given by the Belgian expert Ir. G. Demets about 20 years ago. The retting time varies from 3 to 9 days in summer-time at temperatures from 35° down to 25° C and from 6 to 15 days in winter-time at temperatures from 25° (with heating) down to 15° C without heating. The duration of the retting depends on the temperature and freshness of the water. The capacity of the tanks is about 5 to 11 ton of straw and the straw is piled up in two layers.

Installation of a deseeding machine with a binder whereby two strings instead of one, (see photo 8) are tied around the sheaves, enables the filling of the retting tank to be done more carefully and efficiently.

In the period of twenty years the retting systems and the construction have been improved in the meanwhile. Generally speaking, in Holland one can divide the duration of the retting into three periods, namely:

a. period of leaching,
b. period of development of the retting-bacteria,
c. period of main retting.

The first period lasts, depending on water temperature and quality of the straw from 4 to 10 hours. Bad quality straw will ret more quickly than good quality straw.

The second period lasts 14 to 16 hours and causes a rise of the water level in the tank.

The third period gives a bubbling of the water and can last up to 2 weeks if the straw is of a good quality.

There are three retting systems, put in practice in Holland, i.e.:

1. system of retting with periodical refreshing.

Starting with water of 30° C the water is refreshed two times a day about 30 minutes with water of 45-75° C to an average maximum of 36° C of the water temperature. Each refreshing should increase the temperature in the tank not more than 2° C. The goal of refreshing is: increasing and regulating the temperature of the water and removal of the retting-mud.
2. System of retting with constant temperature.
After the leaching period the tank is kept automatically at a constant temperature of 35-36° C throughout the retting by a circulating pump with water of about 70° C, thermostatically controlled and sprayed in the tank by perforated tubes rounded in a spiral on the floor. The advantages are uniform and more rapid retting, less water supply and less heating. The process is said to be cheaper than the conventional method.

3. System of retting with increasing temperature without refreshing. As for the former system a spiral heating on the floor is necessary which calls for higher investment costs. The flax will be inundated at a temperature of 30° C after having been previously leached and each day the thermostat is adjusted 2° C higher until the temperature of the water has reached a maximum of 36° C.

Of these 3 above mentioned systems the second system is preferred in practice, though the costs of investments are rather high, compared with the first system. The sizes of the tank are from 4 x 5 x 2,5 to 6 x 5 x 2,5 or 50 to 75 cubic meters.

The straw content is about 4 to 7 tons of deseeded straw and the straw water ratio is from 1 : 13 to 1 : 16. Therefore the sheaves have to be put in very carefully overlapping each other upwards in 2 or 3 layers with the butt or the top of the sheaves up and down in alternative layers. The walls of the retting tank have to be made of good insulating material with a smooth surface. Filling, draining and discharging of the tank have to be carried out in a rapid and easy way. The more carefully the flax straw is stored in the tank, the more the contents and the less the loss through waste. Uniform water circulation, and regular control of temperature and state of retting is necessary to finish the retting at the exact time. Retting too short gives rise to difficulties in scutching and eliminating the shives and retting too long results in weak long fibre and heavy losses of long fibre in tow. The newest system is to ret in containers of wire-gauze of 2,5 x 2,5 x 3 m³ and to put six containers with a travelling crane into a big tank with sizes of 15 x 5 x 3 m³. Re-using of a small part of the retting water of a former retting period can sometimes be recommended when starting a new retting. The retting can also be accelerated by applying urea (0,3 gr./m³ of water). Finally the chemical analysis of the water has not to exceed the following percentage of chemical substances, viz. lime content (CaO) max. 150 mgr/litre, iron (Fe) max. 2,5 mgr/litre and chlorine (Cl) max. 500 mgr/litre.

The cheaper system of dew retting, as normally carried out in France, has not been taken in consideration, because this system, which needs alternatively rain and sunshine and gives a lot of seed-loss, is not suitable under the Egyptian circumstances.

c. Mangling and drying of the retted flax straw

In Egypt the retted straw is normally dried naturally immediately after retting in "wigwams" in the field. During the drying the "wigwams" will be turned once to dry the inside-part and thanks to the sunshine the drying is completed within two days. Formerly in Holland in some mills the retted straw first passed through a press where the retted straw was washed laminated and then dried in the field.

A feature of the laminating mangle is that both rollers are driven, which prevents any damage to the fibre and in this way one can get rid of most of the mud, wax and other adherent substances.

For artificial drying this mangle is essential but for Egyptian circumstances the system of artificial drying is too costly and out of the question. After drying, the "wigwams" can be picked up and tied in sheaves by a special binding machine.
d. Conditioning and scutching the straw

After drying, the retted straw has to be stored and conditioned prior to scutching. Experiments have shown that the best humidity percentage of the straw for optimal scutching is 14-16%. The straw has therefore to be stored for several weeks in store-houses, which can be conditioned or at least have been provided with a sprinkling installation to arrive at an optimal and uniform moisture content of the straw.

For turbine scutching, one of the most important factors is the regular and equal feeding of the machine, to obtain evenness of the lower end of the stems in the straw-layer which is essential to get the best scutching results. The installation of an automatic flax-distributor and a double flax breaker before the scutching turbine will improve the capacity of the turbine and the quality of the work (see photo 9 appendix V). There are different types of good scutching turbines, mostly constructed in Belgium, such as Depoortere, Vandommele and Vanhauwaert (see table 9) and a special Van Steenkiste-machine for broken flax (lin brisé) from low grade straw. The capacity of the machines is about 700 kg straw or 150 kg long fibre per hour and they require 3-4 workers at the feet and 3-4 workers at the delivery end.

The same manufacturers also make machines for tow-scutching and there also are the Meister-tow scutcher (Etrich Type) with pre-dryer. Long fibre and tow have to be conditioned during storing and before baling.

In visiting the different mills, the equipment looks in general quite modern, but adjusting the turbines to the quality of the straw, preventing overfeeding, regular control of the speed of the drums and careful handling, should be taken in consideration by the responsible foremen. The low percentages of long fibre (10%) and the high percentage of tow in comparison with the results obtained by scutching-turbines in the flax mills in Western-Europe (18%) prove that in Egypt, improvements in the processing of flax are still possible.

However, appropriate research and improvements are only possible if flax plays an important part in the local needs and the export-trade-balance and if the necessary investment is warranted. On the other hand, the growing and processing of flax can be made profitable only if use can be made of the results of the latest research and of the latest machines. Full recovery of by-products is economically necessary for working. There is a market for seed, chaff, shives, green fibre from deseeding machines, tow, pluckings and short fibre (waste) for paper making to make the sale of these by-products profitable. Long fibre is delivered in bales of 200 kg, tow in bales of 150 kg and waste in bales of 100 kg. In practice the export of these flax products is rather difficult because of a surplus on the markets in Europe. For tow the demand has recently improved because of shortages of the supply.

e. Spinning and weaving

The visits to the spinning- and weaving mills (which were not, because of the construction and expansion, always clean and orderly) provided the opportunity to examine a wide variety of long fibre and tow, yarns and linen products. Spinning and weaving is the country's leading industry. Though the cotton textile industry is by far the leading branch, it is like flax, coming second to cotton, entirely dependant on the local crop. The best qualities of long fibre are destined for export and only the medium and poorer qualities are available for local manufacturing. The mills can buy the long fibre through the intermediary of the cooperations for an average price of 165 E£/ton. Compared with the average price of 210 E£/ton on the West-European market for medium quality, this price is not unsatisfactory for the flax processing mills.
In practice, the instructions to make fine yarn and linen products of high quality out of medium and bad fiber quality is rather difficult to fulfil. Bearing this in mind the manufactured linen products are quite good though not to be compared with the big assortment of the new linen products from the Irish Linen Guild and France at present available on the world market.

One of the biggest handicaps is the fact that the lots of long fibre are not of a uniform quality and composition. This makes the hackling carding, drawing, roving, twisting, wet- or dry spinning and polishing rather difficult for yarns and twines as well. The quality of the samples taken to Holland has been examined by experts and has shown that fineness, regularity and strength are not up to West-European standards. However there had recently been in Western-Europe a complete rationalization, mechanization and automatization with use of modified technologies in spinning and finishing and this evolution is still continuing. The goal is to make linen a "strong" product, in competition with cotton and synthetic fibres, using the attractive properties which linen already had such as brilliant lustre, good and rapid absorption, strength, no fluffing and good dyeing and heat-conducting properties. In this way an international working group for technical and technological research is collaborating to the mutual benefit of the linen industry, bearing in mind the revolutionary steps in the production of flax yarns by new methods of fibre treatment, whether in rove or other form. The same could be said in regard to blends of flax with synthetic fibres.

f. Board manufacture from shives

In Egypt, as in Europe, shives are used for board manufacture. In Egypt however, the shives are sold to the board factories for 8 E£/ton whereas the price in West-Europe is more than double, viz. 17 E£/ton and still it is a lucrative venture. The shives are collected from the scutch mills by trailers and unloaded by automatic conveyor at the board factories. Cleaning and drying of the shives is also mechanized and afterwards the shives are stored in silos. For manufacture the shives are mixed with resin, spread automatically in the feed trays, pass automatically to the press (Sumpelkamp) and polymerisation unit and are stamped and trimmed automatically. The finished products can be veneered, polyester coated, painted or sold in the natural state, in different size and thickness. The boards are suitable for manufacturing all kinds of furnitures and walls and the insulation properties are good. The price for boards in Egypt is, depending on the thickness, 50 E£/ton which is rather low compared with the prices in Western-Europe.

g. Linseed

As in Europe linseed is send to the oil factories to be crushed and pressed. Linseed oil in Europe is only used for paints and varnishes but in Egypt it is partly sold as edible ("hot") oil, though cotton seed oil is mostly used for consumption. The price for linseed in Egypt is rather high (75 E£/ton. Linseed cake is very suitable for cattle-feed.

h. Manufacturing of ropes, cords and strings

The flax tow in Egypt is used for making rope and string for local purposes and for export to Greece and Sudan. However the manufacturing of rope in Europe has changed from flax tow to synthetic fibres and in the case of string from flax tow to paper and plastic string. Moreover, tarpaulins are now made of synthetic fibres instead of flax tow.
Therefore the spinners have, thanks to research, now succeeded in making line yarns from flax tow and by special chemical treatment "Linron fibre". Presumably these products will be a better outlet for tow than manufacturing rope and string in the future.

Finally in Holland, France and N.Ireland many research workers are engaged on a new project in processing raw green flax straw directly to bleached wet spun yarns. If they succeed this will be a complete revolution in manufacturing linen yarns.

It will therefore be seen that in the processing and spinning of flax there is remarkable progress which will be very important for the future of linen products. The average wage rate per day in Europe is about six times as high as in Egypt for skilled labourers. Although labour saving is not so urgent for mechanization, nevertheless rationalization could also be profitable for Egypt.

Anticipating the results of research which is suggested and eventual improvement in growing flax, it may be said that an improvement in the uniformity of the flax straw during the retting, scutching and spinning is potentially present and should be strongly taken in consideration. It should also be recorded that several circumstances during harvesting and processing of the flax are more favourable than those prevailing in Holland.

Perhaps, it could be considered to send one staff member of the Research Institute or one from one of the flax mills to Holland, for a period of approximately three months, from May-July, for the purpose making him acquainted with the methods applicable in Western-Europe.

When proposing some improvements it should be borne in mind that with a more careful handling of the flax straw, in some cases the production will be reduced. In how far this could be profitable, in view of the rather low wages, has not been entered into, as it is outside the scope of this investigation.
IV. RESULTS OF THE INVESTIGATION ON KENAF (Hibiscus cannabinus L.)
(local name = teel)

1. The potentialities in Egypt for growing kenaf

The area actually sown with kenaf is about 1500 feddans (between 1000 and 2000 feddans), producing nearly 1000 tons of spinnable fibres. However, at the end of the Second Economic Development Plan the area under kenaf is expected to be 40000 feddans, producing about 27000 tons of spinnable fibres to supply the local factories of the General Jute Products Company. As the annually import from Pakistan and India nearly 15000 tons of manufactured sacks and bags is and 28000 tons of jute fibres to supply the local factories in Egypt, this development plan for the future is completely justified to save foreign currency. Moreover kenaf has already long been grown in Egypt as a hedge around the cotton fields and the farmer used the fibre of these hedges in preparing ropes for his own purpose. But now the teel plant has to be grown as an economical field crop to supply the local Jute factories, and to make Egypt strategically independant for its jute fibre and bagging.

With roselle (Hibiscus sabdariffa var. altissima) kenaf is the leading jute substitute fibre and can be grown in the tropics and subtropics. The northern limit for kenaf and roselle is about 45° N, the altitude from sea level to 600 m. Both varieties are annual short-day plants, sensitive to frost. However, kenaf needs 4-5 months (90 to 150 days after seeding) and roselle 7-8 months to grow from 2,5 up to 4,5 m. They grow best on well drained loams or light clays; highly saline or strongly acid soils are not suitable for kenaf. On poorly drained soils or on soil not to be irrigated, plants are stunted and usually die before flowering at a short length. An adequate rainfall of 50 to 100 mm or the equivalent in irrigation water - unequal intervals of about 12 days - over the four to five months period of growth, is essential. Thus kenaf is easy to grow, adapts itself to a great variety of soil and climate and is an ideal cash crop for medium and small farms, as well as for cottage-type operations. Kenaf and especially roselle are photoperiodic and the varieties now grown commercially, normally flower when the daylength falls below 12 hours. However new varieties have recently been developed which are substantially less photosensitive thus allowing a great length and a higher production of fibre per hectare.

For this reason kenaf has to be grown in Egypt as a summer crop from April till the end of August or the middle of September, in which case it replaces either maize, rice or sorghum in the rotation.

Finally kenaf does not need much labour for growing, only the harvesting and retting of the stalks to extract the fibre require a lot of labour and time and can be the limiting factors if it is difficult to introduce machinery. Generally however the kenaf is mostly retted and sold as fibre to the bag mills. If the price paid for the fibre gives the farmer a profit equal to that of other summer crops and water for irrigation is available, the farmer will grow kenaf.

Conclusion: soil and weather conditions in Egypt favour growing of kenaf, which is economically justified and will be profitable to the trade balance. After cotton, jute and its substitute kenaf are the world’s financially most valuable commercial fibres, and are of strategic importance in most of the countries of the world.

2. Ways of increasing the yield and quality of kenaf fibre grown in the UAR

In April the Ministry of Industry has finished drafting a comprehensive report on the necessary requirements for raw material. A decision was made
allocating E£ 1,000,000 in convertible currency for the purchase of tops to keep wool factories in regular operation and E£ 750,000 for the import of jute fibres. The total value of sacks, bags and raw jute fibre is calculated at E£ 15 millions a year. From this it follows that the jute textile industry depends entirely on imports of jute fibres. It is for this reason that the Plant Breeding Section projected a "Home Bagging Programme" based on growing kenaf on a large scale in Egypt. However, competition with cotton as a summer crop in the agricultural rotation, makes kenaf difficult to grow commercially. Therefore an attempt should be made to increase the profit for the farmer by improving yield and quality of kenaf-fibres.

As kenaf is a summer crop I could observe only the initial sowing in the fields, the quality of the dried ribbons and the system of retting at the fibre-mill of the General Jute Products Cy. at Bilbeis. Mr. Anas Mohammed Naguib, Head of Research Fibre Crops Section at Giza-Orman also provided much information. From this the following conclusions can be drawn:

a. The yield of long fibre per hectare, in average 1 ton per feddan (25 ton per hectare) is satisfactory in comparison with other countries;
b. Though some fibre-samples at Bilbeis were excellent in colour, strength and length, the medium quality of the bales of dried ribbons delivered by the farmers, is rather poor;
c. The traditional manner of sowing, harvesting and retting kenaf is primitive and needs much manual labour;
d. The sowing seed available is not adequate in standards for yield and purity. Perhaps new varieties could be introduced.

To improve quality and reduce manual labour and production costs per kg fibre (actually calculated at E£ 30 per feddan), the following factors should be considered.

3. Crop rotation and date of sowing

Kenaf ought to be sown after an early winter crop between the middle of April and the middle of May. The area planted every week should depend on the capacity of the available harvesting and processing equipment. Tobacco, groundnuts, cotton or any vegetables (particularly tomatoes and potatoes) should not be used in the crop rotation. Though kenaf grows well on soils with sufficient organic matter, fresh green manure from a preceding crop of clover must be avoided. Mostly wheat, barley, flax and onions, if harvested in time, can be used as preceding crops. The same land should not be used consecutively for more than one kenaf crop.

4. Soil type and preparing of the seedbed

Profitable crops can only be grown on well prepared rich soils. Kenaf is successful in nearly all kinds of soils except those which are highly salted or waterlogged. Therefore the soil must be ploughed to a depth of at least 15 cm and afterwards harrowed and cross harrowed so that the field is level, uniform and smooth and the surface is loose and free from large clods, unbroken lumps and weeds. According to the way of sowing the seed-beds have to be prepared in flat plots 1,5 m - 2 m wide and 5-15 m long or in seed-beds with 14-16 ridges 0,5 m apart and about 5 to 15 m long. The canal system must be dug for irrigation and drainage.

5. Sowing seed and seed production

Kenaf for seed production should be planted in separate fields from kenaf for fibre production. Seed should not be taken from fibre crops, as the seed yield is low and of a poor quality, because fibre crops are usually harvested at full bloom to get more lustrous and softer fibre.
The capsules are therefore not fully ripe. Kenaf is partly self-fertilization and partly cross-pollination, according to the number of honeybees (Apis mellifera) about. To get pure seed of a high standard the plots for seed production should be as separated as possible and for complete isolation at least 300 m away. Areas for seed production require protection from strong winds and the plots have to be sown 4 to 6 weeks later than for fibre crops, to keep the plants short, so that the mature tops can be cut by hand. Row spacings vary according to experience, but for high yield of seed, plants can be easier roqued if at least 30 cm apart. However, experience in southern Florida has shown that plants spaced 5 inches apart in 7-inch rows, yielded significantly more seed than when spaced up to 15 x 28 inches. In Java kenaf and roselle for seed production are planted 75-75 cm at a seed rate of 2 kg/ha in well prepared seedbeds on well drained loams. The seed should be chemically treated to prevent attacks of seedborne parasites. Weed control (Convolvulus spp.) is important in early stages. According to the fertility of the soil an average dressing of 70-80 kg nitrogen per ha, 120-140 kg P2O5 per ha and 90-100 kg K2O per ha is required.

The harvesting can be started, when capsules on the lower and middle branches are ripe. The bolls are commonly cut by hand at intervals and sometimes the tops are stock in the fields to dry for 3-5 days, thus allowing seed on the top branches to mature. Delayed harvest results in shattering of the best seed. In some countries a reaper and binder are used for cutting and later on the seedbolls are passing through a stationary thresher or immediately combined. But threshing is also still done by hand by placing stocks on tarpaulins and flailing with long poles. Every capsule has about 30-40 seeds and the dark seeds are of a better quality (higher germination) than the pale brown or whitish seeds. The 1000-grainweight is about 15 g. The average yield of seed varies from 500 to 1500 kg/ha, roselle yields less, averaging 300-500 kg/ha. Rootrot nematodes (Meloidogyne spp.) and footrots (Pythium, Sclerotium and Phytophthora spp.) can damage the crop but are almost controlled by strict rotation and irrigation technique. Also insect pests such as Dysdareus spp. (cotton stainers), Earles, Podagrica (Nisotra) Javana Motch (black beetle), Phenococcus (Pseudococcus) Lirsutus Green and Empoasca spp. can cause a lot of damage if not controlled in time by spraying with insecticides. The dried and cleaned seed has to be preserved and stored in large air-tight tins. To every tin, a piece of cotton-wool with 1 ml. carbon disulphide should be added to prevent damage by insects. Also for kenaf the use of good quality sowing seed of pure strain, free from seedborne parasites and weeds and good in germination capacity is the base for a good crop.

6. Rate and Method

Seed-drilling or sowing by hand in seed beds or on ridges are the best methods for sowing kenaf. Disinfection of the seed almost ensures the prevention of disease transmission and the sudden appearance of possible new diseases. In various countries, the usual method of sowing is by broadcasting into a shallow-ploughed and harrowed top soil at the rate of 40 kg/ha. Probably because of higher labour requirements, rows with proper spacing between plants are seldom seen, though this method should save much seed and give more uniform plants with a higher yield. Therefore a normal small seed drill, a rice drill or a precision drill is recommended, with a sowing rate of 25 kg/ha.

For fibre production, kenaf should be planted in rows 15 cm apart with plants 15 cm apart. However planting in rows can also be done by hand (photo 10) on seed beds or on ridges, as is usual in Egypt. Planting with a line marked with knots for spacing in the row and a marked lath for spacing between
the rows should be considered. Along the marked knots the labourer makes holes for the plants, about 3 cm deep, with a small dibber. After moving the line to the next row the planters put two germinated seeds in every hole and the next team of labourers fill in the holes. To germinate the seed it is first soaked for about two days in water, changed every 12 hours. The advantages are more equal and rapid development of the plants, less irrigation water needed for sprouting and the crop gets a start on the weeds. Seedlings is required, need not to be thinned, because every hole gives two plants and in this way re-sowing is not necessary. The optimum density is about 600,000 plants per hectare.

7. Varietal Research

Kenaf (Hibiscus cannabinus L.) and roselle (Hibiscus sabdariffa L. var. altissima) are closely related species. They are both species producing bast-fibre of economic importance and are cultivated for it. Roselle is grown commercially only in South-East Asia, whereas kenaf is grown in Asia (Thailand), Africa, Central America and Europe. Roselle is slower growing, not well adapted to machine-harvesting, but certain varieties are resistant to root-knot nematodes. Kenaf has certain advantages over roselle as a fibre crop. It is faster growing and is much more easily ribboned or decorticated than roselle. Breeders have therefore tried to combine the desirable agronomic properties of both varieties. A successful interspecific cross between kenaf, a diploid species (2n = 36) and roselle, a tetraploid species (2n = 72) has been reported in Florida. Moreover thirteen species of Hibiscus, grown in southern Florida, were compared in 1964, but kenaf and roselle yielded best, though kenaf was more susceptible to root-nematodes.

The kenaf varieties Gizah 1, 2 and 3 bred and now commercially grown in Egypt, seem to yield well with a good fibre quality. Yet there has been a remarkable progress elsewhere in breeding new high yielding varieties, more resistant to diseases and less photosensitive, thus allowing an extension of the planting season.

For instance Cubano as an early maturing variety, Cuba 108 and 2032 as medium varieties and Guatemala as a late maturing variety and the varieties Everglades 41 and 71 are already successfully grown commercially in different countries. In view of Egypt's need of the most productive varieties of kenaf, it would be advantageous to import some seed of these varieties, if they be adapted to Egyptian climate and soil and high yielding. Small samples have already been forwarded to the Fibre Crops Research Station at Giza, to study their behaviour in the Egyptian climate.

8. Manuring

For optimum results and maximum yields, nitrogen should be applied, on average 200 kg nitrate of lime per ha (30 to 40 N). Depending on the soil analysis 200 to 300 kg superphosphate and 300 kg muriate of potash can be useful or 500 kg of a 10-10-20 NPK-compound fertilizer/ha. Kenaf responds to superphosphate on nearly all soils and to nitrogen and potash in much the same way as does maize. Organic manure is used if the soil is poor in organic matter, but use of fresh organic matter should be discouraged as it promotes disease.

9. Control of weeds, diseases and pests, and irrigation

In the early stages the crop may need hoeing once and if empty places are frequent, they should be replanted with seedlings. After that the crop needs little attention, because once the crop covers the ground the growth of weeds is reduced. The crop should be irrigated at equal intervals of
5. Tractor driven pulling machine

6. Self propelled pulling machine

7. Deseeding machine with cleaning the seed

8. Binding flax with two strings

9. Scutching turbine with coupled deseeding
about 10 days, that is about 12 times during growth. Every irrigation must be done carefully and requires 800 cubic metre per ha. Infiltration of the soil is better than flooding and a careful planting hygiene will help to prevent outbreak and spread of disease and its distribution.

Kenaf is susceptible to several fungal diseases and therefore more resistant varieties have been bred. Most pests can be controlled by spraying in time with dieldrin, parathion or other insecticides according to the kind of insect. Root-knot nematode is one of the most serious pests and can be controlled only by soil fumigants. However, they are too expensive in the field to warrant their use.

10. Harvesting and processing

There are several methods of harvesting and processing kenaf, depending upon economics and the end use of the product. Harvesting should be started about 120 days after sowing when the crop is in full bloom. In practice some fields have to be harvested rather early because it is naturally impossible to harvest and process large fields of kenaf in only a few days. Some reduction in fibre weight and quality is inevitable for crops cut early or late. The common system of harvesting by hand requires a considerable amount of labour. The stalks are cut with a special knife or sickle as near as possible to ground level; the tips of the leaf crowns are cut off. Afterwards the stalks are trussed and stocked and kept in the field for about a week to allow the leaves to fall. A portion of the tops, which contains no useful commercial fibre, is cut off, to simplify the retting later.

To save labour a tractor-mounted harvester has recently become available (see photo 11) and shows promise for efficient operation.

For retting, bundles can be soaked in small streams, ditches or retting pits dug in the field. The stalks can also be transported on lorries or trucks to be retted centrally in a series of cement tanks near the mill. Depending on the temperature of the water, retting takes 1 to 5 weeks and demands much practice. When retting is complete the fibre is stripped by hand from the stems, washed to remove dirt and dried in the sun.

If the stalks are to be "ribboned" or decorticated, it should be done as soon as possible after cutting, within 36 hours at the most. There are different types of ribboning machines or decorticators (see photo 12) with a capacity of 180 to 300 kg dry ribbons per hour, stationary or mobile as well, available (see photo 12, appendix VI), but they all need regular supervision by a mechanic to keep them in running order. The advantages of ribboning are the elimination of transporting all the stalks and the return of waste (leaves, the woody shives and vegetable matter from the bast) to the soil, where it acts as mulch. The ribboning machine manufactured by Mr Kourshed at the Fibre-Mill at Elbeheis, a hand-fed mobile machine equipped with its own diesel engine, works well. The most important characteristic of ribboning is the complete recovery of fibre from the stems. Afterwards the ribbons have to be dried in the field on lines, constructed of a single wire, strung over wooden posts of bamboo.

However, the need for a mechanic, the high repayments for a machine only working three weeks a year, make ribboning or decorticating and drying the ribbons slightly more expensive than retting by the farmer himself. Moreover the dried ribbons have to be transported in bales to the factory for retting. Attempts to use kenaf ribbons directly for bag manufacture have not been very successful. As a result, central retting plants have been established in several countries. The central plant, which purchases the dried ribbon from the growers, has the advantage that, in view of its large production, it can afford to construct a proper installation and to employ an experienced supervisor. Furthermore it can distribute ret-
ting over the entire year, thus reducing the size of installation required.

The retting installation at Bilbeis, consisting of sixteen canals 150 m long, 1,60 m deep and 2 m wide was planned by Dr. Schneider, fibre expert from Switzerland, and is a marvellous plant (see photo 13). The ribbons are hung on cross-laths in wooden or iron containers, which move against the current of refreshing water (6 m^3/hour). Every container takes 170 kg dried ribbons. Depending on the temperature of the water retting takes 10 days in summer and 15 to 19 days in winter. After retting has been completed the containers are taken out by a travelling crane, the ribbons are washed thoroughly in washing machines and then dried in the sun.

A simple way of retting is in brick basins 17,5 cubic metres, constructed of bricks (see fig. 1 and 2 and photo 14) wherein the ribbons are also hung on bars or sticks. A good ribbon-to-water ratio is 1 : 20 and constant circulation of water (approximately 15 % of the water must be changed daily) is essential. This may be done by allowing the water to flow in and out of the tank during retting.

In Indonesia the complete stalks are soaked and retted, in much bigger basins and any nearby small streams and ditches are used. However, the stalks or ribbons, if not stacked in containers, have to be weighted by stones or planks to keep them soaked in the water.

Water retting is a bacterial process and therefore desirable organisms should be encouraged so that the best quality of fibre is obtained in the least of time. As already said, good retting demands much experience but the retting of bast fibres is one of the oldest arts known to man.

Once the fibre is rilled, it must be washed and cleaned to remove loosened mucilage and mud. This can be done by hand although laminating-washing machines of different types are available. The fibre is then spread on drying lines consisting of wires strung over poles; the drying takes from 8 to 24 hours. After drying the fibre is graded, baled and is then ready for shipment to the factories. A ton of green stalks yields about 4 to 6 % dry, clean fibre.

11. Disposal of retting water

Retting liquor has a high biological oxygen demand, and if large amounts are allowed to enter a low stream, it should first be sprinkled and aerated. Though not poisonous to men, it has an unpleasant odour but it can be used with profit as organic manure by sprinkling it on pasture or fields of fodder crops.

12. Spinning and weaving

The spinning and weaving mill at Bilbeis is excellently equipped with modern machines, mostly from Mackey (N.Ireland).

They are spinning coarse yarns (32-48) and fine yarns (11-14) and are manufacturing 3 types of bags (2,25, 2,5 and 3,25 lb in weight). However, a lot of raw material has to be supplied from Pakistan and Thailand. The central retting plant together with a spinning and weaving mill is a good example of efficient integration.
Indication for the construction of a retting-tank

The walls are made of brick or concrete, slightly reinforced and 5 cm thick. The tank is sunk about 1 m below ground level and rises 0.5 m above the ground. The measures for the tank are: length 5 m, height 1.50 m, width 2.50 m. Balks set into the walls prevent the soaked ribbons rising. The tank is filled by a plastic tube (10 cm diam., running right down to the bottom ("a", fig. 1). By a tube ("b", fig. 1) with a diameter of 5.7 cm, refreshing water flows away. For emptying, the tank has a tube ("c", fig. 1) with a diameter of 10 cm and a tap outside the tank. The ribbons have to be soaked about 20 to 25 cm below water level.
Summary

All ten of the foregoing sub-items and suggestions, after careful study and introduction, could raise higher production and quality. The resources are certainly available. In particular the growing and harvesting of the crop can be improved, and the system of retting by the farmer himself needs serious review.

However, experimental farms and farmers training courses, can educate the farmer. Some experiment and adaptation over a period of time will achieve the best results. Other industries would gain by the products of the kenaf industry, especially those of sacks, required for such industries as sugar, rice, tobacco and for packing crops such as cotton, wheat, onions, potatoes, groundnuts and other crops. The Egyptian trade balance and independence would be strengthened. The establishment of a kenaf industry is beset with many problems. The central problem for kenaf is to produce a satisfactory product, be it fibre or a manufactured one, at a cost low enough to compete with jute and still high enough to provide the grower and investor with a profit that can compete with other crops, thus warranting investment in a new venture. Recent progress in the agronomics, processing, manufacturing and applications of kenaf, gives promise of economic success in Egypt. This progress must be watched closely, especially the chemical retting and the competition from polypropylene sacking.

Acknowledgments

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Finally I would like to thank the Netherlands Ambassador in Cairo, Dr. Th.P. Bergsma and the Director of the Agricultural Department at the Hague, Ir. J. van Gaalen for their approval of the Egyptian Government’s request for my services over a period of approximately four weeks.

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THE GROWING AND PROCESSING OF FIBRE FLAX IN THE NETHERLANDS
(Lecture at Giza-Research-Centre on 19 April)

Introduction

The total area of farm land in the Netherlands is about 800000 ha. Cereals are the most important crop with an area of 462000 ha, followed by potatoes with 123000 ha and sugar beet with 92000 ha in 1966. The area for flax last year was 18300 ha, in 1965 21700 ha and in 1964 30700 ha. Thus the flax area has diminished in the last three years through the low prices for the flax straw and for the long fibre (see table A and B). This and the price agreements in the Common Market have made it more profitable for the farmers to grow wheat, sugar beet or potatoes. Fibre flax (oilseed flax is not grown in the Netherlands) is almost confined to the good marine clay soils along the coast. Half the area sown in 1966 was in the south-west of our country, about 6900 ha in the new polders of the former Zuyder Zee and about 2100 ha in the northern clay regions of our country. Flax needs a mild climate from the sea and not a too quick initial development, to obtain a good crop rich in fibre of good quality.

Wiera was for the last ten years the most commonly grown variety, more than 90%, but since Fibra and Reina were introduced as new, high yielding varieties, the percentages of Wiera grown in 1966 dropped to 73% (60% in 1967), with Reina 16% and Fibra 11%.

The total flax area for Western Europe was as follows, more or less according to the informal agreement between spinners and flax growers in the International Confederation for Flax and Hemp (CILC) in Paris.

<table>
<thead>
<tr>
<th>Year</th>
<th>Belgium</th>
<th>France</th>
<th>Holland</th>
<th>Total</th>
<th>Decline</th>
</tr>
</thead>
<tbody>
<tr>
<td>1964</td>
<td>39 187 ha</td>
<td>67 437 ha</td>
<td>30 651 ha</td>
<td>137 275</td>
<td>-28,6%</td>
</tr>
<tr>
<td>1965</td>
<td>27 012</td>
<td>49 221</td>
<td>21 623</td>
<td>97 857</td>
<td>-3,6%</td>
</tr>
<tr>
<td>1966</td>
<td>23 554</td>
<td>52 362</td>
<td>18 317</td>
<td>94 333</td>
<td>-22,6%</td>
</tr>
<tr>
<td>1967</td>
<td>14 000</td>
<td>49 500</td>
<td>9 500</td>
<td>73 000</td>
<td>-22,6%</td>
</tr>
</tbody>
</table>

Other West European countries have ceased growing flax, with the exception of Denmark with about 800 hectares for one mill at Kolding.

The spinners need for Western Europe have been calculated at 100000 ha flax providing about 1300 kg fibre/ha each year. According to yearly estimated consumption and the stocks of long fibre and tow in the spinning mill, the total area can be increased or reduced every year at the Congress of the CILC according to the informal agreement between flax growers and flax spinners in Western-Europe.

Perhaps it may be possible that the UAR can also join the CILC where eleven West European countries are collaborating in discussions of the problems in the flax and linen industry.

A. The economy of growing fibre flax in Holland

The aim of growing flax in the Netherlands is to supply the Dutch flax mills which take about 30% of the total crop production, with flax straw.

The remainder of the total production of flax straw is bound for export to Belgian flax mills. In 1965 101531 tons of not deseeded flax straw and 32014 tons of deseeded straw was exported for a total amount of Du.fl.\(^1\) 29 718 471 (= about E.£ 3 580 540) at an average price of 21,3 ct (= 2,6 pt.) for not deseeded and 25,9 ct (= 3,6 pt) per kg for deseeded straw. Including an amount of Du.fl. 20 300 000 (= E.£ 2 445 783) for other flax products exported as long fibre, tow and sowing seed, flax makes an important contribution to our trade balance with more than E.£ 6 million in foreign currency.

\(^1\) 1 E.£ = 8,27 Du.fl.
Table A. Price-changes for 100 kg not deseeded flax straw in Belgium

\begin{center}
\begin{tabular}{l}
\hline
Month & Price (Du.fl.) \\
\hline
Jan. & 24.14 \\
Febr. & 23.43 \\
Mar. & 22.72 \\
Apr. & 22.01 \\
May & 21.30 \\
June & 20.59 \\
July & 19.88 \\
Aug. & 19.17 \\
Sept. & 18.46 \\
Oct. & 17.75 \\
Nov. & 17.04 \\
Dec. & 16.33 \\
\hline
\end{tabular}
\end{center}

\[1 	ext{ E.L.} = 8.27 	ext{ Du.fl.}\]
Table B. Price-changes for long fibre by the kilogram

1 E.E. = 8,27 Døl.
To stimulate the growing and processing of flax in competition with other crops such as wheat and sugar beet the Government gives a subsidy. This subsidy is Du.fl. 200/ha for the flax processing industry in the Netherlands, in Belgium it is Du.fl. 140/ha for the farmer and a total subsidy of Du.fl. 300 for the flax grower and processor together in France.

The Dutch farmer is only interested in growing flax when he will get about Du.fl. 2000/ha (= about E.£ 240) for his crop, or 3 piastres/kg not deseeded straw. The Belgian and French farmer is content with only Du.fl. 1500 (= E.£ 180) because he is paying less in tax, social care and landrent.

In spite of dew retting of flax in France, the unfavourable climatic conditions of 1966 cut the profit for members of the French flax cooperatives from 3695 Fr. (= Du.fl. 2700 = E.£ 32,4)/ha in former years to 1458 Fr. (= Du.fl. 1064 = E.£ 14)/ ha in 1966. The French farmer is content with an average financial outcome of about 2000 Fr. = Du.fl. 1500 = E.£ 18.

How we grow fibre flax in our country

For the farmer the most important consideration is the reliability of his crop and the yield of straw of a good quality. There are various ways he can go to achieve these results without any risk of lodging or disease, which in the Dutch climate may happen almost any year with bad weather during ripening and harvesting. He must consider the following factors.

1. Crop rotation

Clover preferably followed by an oat crop or perhaps another cereal crop or onions are considered the best crops to proceed. Flax should not be grown on the same ground for at least six years thereafter, to avoid the risk of serious attacks of scorch (Pythium megalacanthum). Virgin soils or pastures are not considered suitable immediately before a flax crop. In an emergency sugar beet, peas or potatoes can precede flax if the fertility and structure of the soil is up to standard and free from weeds.

2. Soil type and preparation of the seedbed

Flax requires a not too heavy clay or sandy clay, calcareous and well drained. On average a good flax soil has the following composition: pH KCl 6.7 (with more than 4.5% organic matter, pH should be lower). humus (organic matter) 3-4 %
CaCO₃ (lime) % > 1,0
total sand 16%, 55-65 %
coarse sand 90%, 10 %
fine sand 16-90%, 55-60 %
lutum 16%, 35-45 %
P-citr. number 32-44
potash number 16-20

The preparation should aim at attainment of as level a seedbed as possible of fine tilth, a primary requirement to ensure even germination and growth to a uniform length, thickness and quality of the straw. Ploughing 10 or 15 cm deep, then cross-harrowing and levelling the soil, is preferable to avoid making the soil too loose to too great a depth because the seed must be sown superficially.

3. Sowing time and quality of the seed

The earlier sown the better the yield, fibre content and resistance to lodging. But a good structure of the soil is more important than early sowing.
The use of seed of pure strain, free from seed-borne parasites and of good germination capacity and purity (freedom from weeds) is most important for the attainment of a product of high quality. The General Netherlands Inspection Service for Seeds of Field Crops and for Seed Potatoes (NAK) guarantees the quality of seed through two inspections in the paddocks during flowering and through strict supervision during transport, stacking, threshing and cleaning of the seed. Finally through sampling and certifying each bag meant for sale and distribution to the farmer as seed. Each bag contains a certificate giving all particulars such as origin, variety, class foundation (original, 1st, 2nd, or older multiplication). On request the Government Seed Testing Station will provide information on germination capacity, percentage of diseases and weeds and threshing damage. Seed submitted but not up to the established standards is rejected and sold to linseed oil factories at world-market prices of about 40 ct (= 5 pt)/kg.

So a good farmer can be paid for his straw and for his seed as well. The price he can get for the seed is at least 55 ct/kg (about 7 pt), according to the variety and class of multiplication. The farmer has to pay for the disinfected sowing seed about 80 ct up to 1 gld./kg depending on the variety and class of multiplication.

The International Convention of Paris will allow only stock seed (semences de base) and certified seed (semences certifiées) to be sold from 1970.

4. Seed disinfection

Disinfection of the flax seed for propagation purposes, is compulsory in the Netherlands to control disease carried on the seed. This almost prevents transmission of diseases and sudden outbreak of any new diseases. The cost of disinfection of seed is minimal and can control attacks of Botrytis cinerea (grey mould), Ascochyta linicola (dead stalks), Fusarium lini (seedling disease) and Polyspora lini (browning). Only fungicides permitted and recommended by the Plant Protection Service may be used and applied. These are the fungicides based on TMTD (powder and slurry), mercury (powder and liquid), mixtures of TMTD and mercury and TMTD with quinone at a rate of 3 g/ml/kg.

To control the flea-beetle (Aphtoneta euphorbiae or Longitarsus parvulus) a fungicide based on TMTD + lindane at a rate of 5 g/kg seed is advised. The red volatile liquid mercurials are highly recommended and mostly all seed dealers distribute reddish seed, so treated.

5. Method and Rate of sowing

The customary system of sowing flax in Holland is in rows of 8 cm apart with the same drill as used for sowing cereals, peas, rape or poppies, by simply removing the tubes and adjusting the machine for every special crop. There also are special flax drills which can sow the flax in rows of 4, 5, 5, 8 up till 11 cm apart. However, the closer the rows the more uniform the crop and the more resistant to lodging.

These machines can be adjusted to sow accurately at any seed rate within limits of ± 5 kg/ha.

Seed is no longer broadcasted in our country because it gives an unequal germination and growing of the flax (more under flax of a very short length 20-40 cm). The farmer also needs more seed/ha than for drilling to get the same number of plants per m². The rate of drilling varies from 140 kg/ha on heavy soils with early sowing to 110-120 kg/ha on lighter soils with late sowing. An average of 1800-2000 plants per sq. meter is best.

Too high a density gives more lodging and disease, a low density causes coarseness and too much branching of the straw.

A good flax drill costs about £ 325 in the Netherlands.
6. Undersown crops

Undersown crops with flax are not customary in Egypt. In the Netherlands the possibility of undersowing crops makes flax more profitable for the farmer as he has a second crop of i.g. clover (white clover, Trifolium repens, lucerne, Medicago sativa, yellow trefoil, Medicago lupulina) or grass (meadowgrass Poa pratense or red fescue Festuca rubra) for seed after pulling the flax.

However, such undersown crops are restricted to low growing clover varieties as forage crops or to low growing grasses for seed multiplication and production.

The clover or the grass may be sown at the same time as flax. To make sure the clover does not damage the flax quality by an abundant growth, it may be sown 2 or 3 weeks after the flax.

7. Fertilizers

Dressings vary with the fertility of the soil and its composition. On average the following ones are the rates to be applied:

- Nitrogen as calcium nitrate 15% N 0-200 kg/ha for fertile soils
- Nitrogen as calcium ammonium nitrate 23% N 200 kg/ha for rather poor soils
- Superphosphate 19% P2O5 200-400 kg/ha
- Muriate of potash 26% K2O 300-400 kg/ha

The rate of phosphate and potash depends also on the following crop and will often be applied as a safeguard. Use of NPK compound fertilizers is increasing.

The rate of manuring in the Netherlands is rather high, but with the heavy rainfall (700-1000 mm a year) there is a risk that the minerals will be leached or washed out of the soil.

8. Variety research

The Dutch flax breeders have always played a leading role in the breeding of high yielding varieties of fibre flax. Concurrent and Wiera are known all over the world.

According to the latest Farmers' Bulletin there are five enlisted varieties, namely Wiera, Fibra, Reina, Hera and Primo, which the farmer may grow. He may not grow any variety not listed in the Dutch Descriptive List of Varieties of Field Crops even though they are already grown in other countries. Before a new variety can be listed it has to be tested for at least three years.

In the preliminary test the variety must meet three requirements:
1. It must be proved to be a new variety, different from other varieties in varietal characteristics
2. It must be a pure strain
3. It must not yet have been marketed.

After it has been approved for this 3 criteria, the testing can start after the variety has been registered under a name in the Central List of Registered Varieties. The testing will be against Wiera, Fibra and Reina as standards and also for resistance to rust and scorch by the Institute for Phytopathological Research.

If the results for at least two years demonstrate, that the tested variety is better in yield, quality and resistance to lodging and disease than the already commonly grown varieties, it can be listed. Thereafter the seed can be marketed and distributed, when the Seed Inspection Service has approved the seed as up to standard for quality.

During the last five years varietal research has been extended to international collaboration with 10 countries. Every country interested, can cooperate in
this international scheme. The seed for these international varietal trials will be distributed every year from Wageningen by the Institute for Research on Varieties of Field Crops which acts as the centre for distribution. The research in these trials will continue this year when varieties will be compared in the spinning mills, because the spinners are the buyers of the fibre.

Besides the Dutch varieties and selections the trials this year also include the new French variety Tissandre and a Belgian selection from the Breeding Station Gembloux, H 422-4. Varieties not listed can only be distributed while acknowledging the rights of the breeders beforehand.

In my opinion Giza-4 is a variety yielding well. However, besides its good varietal characteristics, its great length must be ascribed to the shorter day-length during growth than in the Netherlands. Moreover the experience of our breeders is that a variety cannot be bred for dual purpose, namely a good yield of fibre and a good yield of seed. As our stock breeders say: "You can never cut and get two good backs with sufficient meat and fat out of one pig".

The average figures for the Dutch varieties are:
- Straw not deseeded: 8000 kg/ha
- Straw deseeded: 6000 kg/ha
- Seed: 950 kg/ha
- Content of long fibre: 20%
- Content of tow fibre: 5%
- Long fibre: about 1,2 ton/ha
- Tow fibre: 300 kg/ha
- Total fibre: 1500 kg/ha

9. Control of diseases, pests and weed

The entire control of diseases should be sought in disinfection of seed and the breeding of disease-resistant varieties.

Attacks by flee-beetles and thrips (Thrips angusticeps and Thrips lini) can easily be controlled with the following products:
- parathion 25% 1,6 kg or 1,6 litre/ha
- dieldrin 25% 1 kg or 1 litre/ha

The most important fact is, that the dusting or spraying of the products has to be done in good time, before the attack has spread over the whole field. For chemical control of weeds two kinds of herbicide are available.

1. Soil herbicides (pre-emergency products), to be applied just after sowing and before the flax has germinated. These products are:
- Lennacl 1 kg/ha Dupont
- Linuron 3/4 kg/ha Aagrunol
- Buturon 2 kg/ha BASF
- Gesudin 2079 3 kg/ha Geigy

2. Post-emergency products, applied if the flax plant is 5 to 10 cm high. These products are: MCPA 1/3 - 1/3 of the dose-rate for cereals ICI
- NaDNOC 8-10 kg Sandoz
- Mixtures of NaDNOC + MCPA 5-6 litre Aagrunol
- Mixtures of Toxynil + MCPA 1 litre Luxan

All these products must be sprayed in 600-800 litre water/ha and only if the flax plants are dry. Insecticides can be sprayed from the air by plane, but aerial spraying of herbicides is for flax still impractical.
10. **Date and method of harvesting**

Flax should not be pulled too early (low weight of straw and seed) nor too late (difficult to ret and poor fibre).

The most suitable time is, when the stem is yellow-ripe and has lost leaves half way up its length, and the seed is yellow or light brown.

Pulling in the Netherlands is only done by pulling machines. There are different types of pulling machines. The biggest and newest self-propelled machine pulls the flax in front of the machine. The machine can pull and bind 0.5 ha per hour in strips 1.40 m wide and weighs 2600 kg. Several machines can also be used for pulling and spreading the flax in the field with a pick-up binder. The price of this machine is approximately E£ 2500. Because there is no risk of rain in Egypt during harvesting time the flax straw can be pulled and bound by machines without difficulties. In the Netherlands the flax must be dried in stocks of six sheaves and later on put on tripods.

11. **Threshing the flax straw**

The flax straw in the Netherlands can only be threshed in the barns of the farms or of the seed-dealers by deseeding machines. The best deseeding machine which also cleans the seed is "De Mooie Molen". The capacity is about 1 ton straw per hour and the price is approximately E£ 250. It may be possible to make this machine less cumbersome on wheels so that it can be pulled by a tractor and used for deseeding flax in the field.

**Resumé:** It can be stated that all foregoing eleven sections, after careful study and putting into practice, can lead to higher production and better quality.

However it should be particularly noted that experience gained in the Netherlands cannot be adopted in the UAR without further careful research. The potentialities are certainly there, because the Fibre Research Station has competent workers, experienced in flax problems and only happy if they can improve yield and quality.

**B. Processing flax straw**

When proposing some improvements it should be borne in mind that with a more careful handling of the flax straw, the production capacity may be reduced. Although the processing of the flax is a very labour intensive industry (about 70% of the total processing costs) mechanization is urgently needed.

The following improvements can at first sight be recommended: after having visited the El Kirratien flax mill.

1. Greater evenness of the butt and careful tying of the sheaves after deseeding will be desirable.
2. Installation of a "binder" whereby two strings instead of one are tied around the sheaves will improve the efficiency of filling the retting tanks.
3. The more even the sheaves the easier the drying of the sheaves after retting in the field and the less the scutching loss in the turbines. The supply in the machine can be more regular and could give a higher percentage of long fibre of a better quality, with a greater capacity of the scutching turbine.

To reduce the costs of retting a lot of systems have been studied to accelerate retting and to improve the fibre quality. Generally speaking, there are three systems of retting and processing the flax straw:

a. The cheapest system is dew retting of the flax as normal in France, where more than 90% of the total flax crop is dew retted. As a regular rainfall is indispensable for dew-retting, it is outside the scope for Egypt. Moreover dew-retting gives an average loss of seed of about 50%.
Finally dew-retted flax fibre is more suitable for dry-spinning and gives only medium fine yarns 30 Nm or 50 Lea.

b. Warmwater retting in tanks of about 40-50 cubic metres is far more expensive, though it gives a better quality of long fibre. Tank retting can be accelerated by using containers (bunkers of iron wire gauze) and adding urea to the water (0.17 - 0.20 g urea/litre). Artificial drying is in 9 of the 12 months presumably not necessary in Egypt's climate. This makes the profitability of the installation of an artificial dryer still more expensive. Perhaps the retting and drying in 9 months can be raised to a quantity that will be enough to supply the scutching turbines for 12 months of work. However a tunnel for conditioning the straw to the most suitable humidity for scutching (about 15%) will be advisable to eliminate storage of the dried straw and to get the highest content of long fibre by scutching.

c. The newest processing system for flax that is still under study, and now to be introduced in pilot plants in France and in the Netherlands, is as follows. The deseeded dried green flax straw passes six pairs of fluted breaker rolls for green scutching of the flax; after hackling, the green fibre comes free from wooden shives out of the green scutching machine. The best results are obtained with 12% moisture of the straw and a capacity of 750 kg straw per hour. After carding the sliver must be spun as a coarse yarn on steel bobbins and is treated by chemicals for a degumming process and immediately after is spun to a bleached wet-spun yarn of 40 to 60 metric number. The yarns obtained are more regular, stronger and finer than from dew-retted fibre. The costs for the yarn will be 25% less than for tank-retted yarns. The most important difficulties are:

1. The differences in quality of raw material, i.e. in the green flax straw
2. Mechanical troubles in processing machinery for green scutching to get green fibre free from wooden shives
3. Lower outputs of long fibre and yarn if the flax straw has lodged
4. The normal spinning and weaving system has to be improved and to be adapted to the chemically treated flax fibre
5. Ways of using spinning mixtures of flax fibre with synthetic fibres are still under study

For the future of the linen industry it is urgently necessary that the international collaboration in technical research between Belgium, France, Germany, Holland and Northern Ireland will be continued to our mutual benefit. Growing and processing of flax can be made profitable only if the results of recent research, the best machines and the most efficient and cheapest processing methods can be applied.
THE GROWING AND PROCESSING OF KENAF (Hibiscus cannabinis)
(Lecture at Giza-Research Centre on 25 April 1967)

Introduction

In the last 30 years a new fibre crop has appeared to replace jute fibre for manufacturing different kinds of bag, burlap carpets and linoleum backing tying cords. Gradually the acreage under kenaf (teel) and the production of kenaf fibre increased, despite the efforts of India and Pakistan to stop the enlargement of the production to compete with the jute fibres and to keep their prices for jute on a high level.

In 1966-67 the acreage and production of kenaf was as follows (figures from the FAO statistics):

<table>
<thead>
<tr>
<th>Countries</th>
<th>Area under kenaf thousand acres</th>
<th>Production in 1000 tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>280</td>
<td>300</td>
</tr>
<tr>
<td>India</td>
<td>800</td>
<td>270</td>
</tr>
<tr>
<td>Indonesia</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Iran</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Thailand</td>
<td>535</td>
<td>530</td>
</tr>
<tr>
<td>Spain</td>
<td>1</td>
<td>sp.</td>
</tr>
<tr>
<td>South Vietnam</td>
<td>2</td>
<td>0,5</td>
</tr>
<tr>
<td>USSR</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Pakistan</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>Brasil</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Congo</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Mozambique</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>North-Vietnam</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Cuba</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Birma</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Taiwan</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Northern Nigeria</td>
<td>1</td>
<td>0,8</td>
</tr>
<tr>
<td>Eastern Nigeria</td>
<td>8</td>
<td>0,5</td>
</tr>
<tr>
<td>Ghana</td>
<td>1</td>
<td>0,8</td>
</tr>
<tr>
<td>UAR</td>
<td>2</td>
<td>1,5</td>
</tr>
<tr>
<td>South Africa</td>
<td>experimental stage</td>
<td>0,-</td>
</tr>
<tr>
<td>Sudan</td>
<td>experimental stage</td>
<td>0,-</td>
</tr>
<tr>
<td>Madagascar</td>
<td>experimental stage</td>
<td>2</td>
</tr>
<tr>
<td>Tunis</td>
<td>experimental stage</td>
<td>-</td>
</tr>
<tr>
<td><strong>Overall total</strong></td>
<td><strong>1328</strong></td>
<td><strong>1310</strong></td>
</tr>
</tbody>
</table>

The forecast of supplies, domestic requirements, export availabilities, and import requirements 1967/68 are given in table 1 and 2.
Table 1. Forecast of supplies, domestic requirements, export availabilities, and import requirements, 1967/68

<table>
<thead>
<tr>
<th></th>
<th>Pakistan</th>
<th>Thailand</th>
<th>India</th>
<th>Other Exporters</th>
<th>Other Exporters (estimated)</th>
<th>World</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Exporters</td>
<td>Exporters</td>
<td></td>
</tr>
<tr>
<td>Opening carryover</td>
<td>261</td>
<td>120</td>
<td>337</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production</td>
<td>1,260</td>
<td>350</td>
<td>1,368</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Import requirements forecast</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>955</td>
<td>955</td>
</tr>
<tr>
<td>Total forecast supply</td>
<td>1,521</td>
<td>470</td>
<td>1,705</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mill consumption</td>
<td>540</td>
<td>752</td>
<td>1,296</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Village consumption</td>
<td>45</td>
<td>-</td>
<td>36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Closing carryover</td>
<td>180</td>
<td>70</td>
<td>337</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forecast domestic requirements</td>
<td>765</td>
<td>145</td>
<td>1,669</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forecast export availabilities</td>
<td>756</td>
<td>325</td>
<td>36</td>
<td>25</td>
<td>-</td>
<td>1,142</td>
</tr>
</tbody>
</table>

1 See Table 2
2 Including village consumption
3 Converted from data in lakh bales at 180 kg per bale

Table 2. Forecast import requirements, 1967/68

<table>
<thead>
<tr>
<th></th>
<th>1000 metric tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium a</td>
<td>100</td>
</tr>
<tr>
<td>France</td>
<td>75</td>
</tr>
<tr>
<td>Germany, Fed. Rep. a</td>
<td>60</td>
</tr>
<tr>
<td>Italy</td>
<td>40</td>
</tr>
<tr>
<td>Netherlands</td>
<td></td>
</tr>
<tr>
<td>Total E.E.C.</td>
<td>285</td>
</tr>
<tr>
<td>Austria</td>
<td>5 b</td>
</tr>
<tr>
<td>Portugal</td>
<td>42 c</td>
</tr>
<tr>
<td>Scandinavia</td>
<td>6 b</td>
</tr>
<tr>
<td>Spain</td>
<td>32</td>
</tr>
<tr>
<td>United Kingdom and Ireland</td>
<td>126</td>
</tr>
<tr>
<td>Total Western Europe d</td>
<td>484 e</td>
</tr>
<tr>
<td>India</td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td>110</td>
</tr>
<tr>
<td>Poland</td>
<td>24</td>
</tr>
<tr>
<td>United States</td>
<td>51</td>
</tr>
<tr>
<td>Rest of the World</td>
<td>286 b</td>
</tr>
<tr>
<td>WORLD TOTAL</td>
<td>955</td>
</tr>
</tbody>
</table>

a Including fibre also required for uses other than spinning
b Estimated by the Committee
c Including 12,000 metric tons Angola and Mozambique
d ABUI member countries
e Excluding Angola and Mozambique

Kenaf is grown under different names such as chanvre de Dacca, Bombay hemp, mesta bimlipatam jute, Java jute, dah, wilde stokroos and teel and can be found from the borders of the Mediterranean and Caspian Sea to South Africa and Asia. Moreover often Kenaf is confused with Roselle (Hibiscus sabdariffa var. altissima). Most of the Kenaf sp. are short-day plants in contrast to flax and are subject to photoperiodism and the varieties presently grown commercially flower when the length of daylight falls below 12½ hours. Kenaf grows from 1 m to more than 4 metres high with a tall woody core surrounded by a fibre bearing bast and topped with a large leafy crown. Though the growing of Kenaf is hardly any problem, the processing of the fibre has given a lot of difficulties and concentrated efforts have been made to produce good, spinnable fibres.
In order to compete economically with jute produced by cheap labour from India and Pakistan, production of kenaf fibre must be mechanized and made more efficient. The goal is to get higher yields of fibre per acre with less manual labour, which is the only way to compete with jute.

The consumption of jute products in the UAR has been estimated at 45000 tons a year. So it will be of the highest importance to introduce the growing and processing of kenaf into Egypt to save much foreign currency, about £E 15 mil. The expected expansion in the area of Kenaf at the end of the Second Plan is estimated at about 15000 feddans, producing nearly 10,000 tons of spinnable fibres.

A. The growing of Kenaf

Kenaf is easy to grow, adapts itself to a great variety of soil and climatic conditions, and is harvested within 90 to 150 days of sowing. It is, thus, an ideal cash crop for medium and small farms, as well as for cottage-type operations.

1. Climate and soil

Kenaf needs rainfall of 500 to 625 mm (or the equivalent in irrigation water, 4 to 5 irrigations) over the four to five months growing period. Kenaf must be grown during the period of longest daylight owing to the photosensitivity of most of the commercially available varieties. However, the use of the recently bred varieties of shorter daylength permits a substantial extension of the growing season.

The most important factor in soil selection absolutely indispensable for kenaf is good drainage. Otherwise the plants remain stunted and are readily attacked by diseases. Light clays or sandy loam soils, if free from weeds, are best and produce the most profitable crops. Very sandy soils need much water and heavy soils require deep discing and well prepared drainage ditches. Saline or strongly acid soils are not suitable for Kenaf, the pH should be between 6 and 7. Kenaf needs a good crop rotation and should not be grown on the same paddock again for at least three years. Neither cotton nor solanaceous vegetables such as tomatoes and potatoes should be used as preceding crops. It must be emphasized that profitable crops can only be grown on good soils.

2. Land preparation

Good land preparation to obtain a uniform and smooth soil, free from weeds and large clods of unbroken lumps is of the greatest importance. Therefore the soil must be ploughed thoroughly before harrowing and cross-harrowing. No seeds should be sown until the land is level and well prepared without any sign of depressions in the seed bed, where water could collect. It is very important to sow immediately after the last tillage.

3. Method of sowing and rate of sowing

Sowing with already germinated seed to get ahead of weeds, is preferred. Therefore the seed should be soaked in water for two or three days, changing the water every day, till the first points of the roots can be distinguished. In this way one can be sure to plant only already germinated seed, which starts growing much quicker and more uniformly than the common dry seed and the quantity of water for irrigation can be decreased because only a moist seedbed is needed.

The quantity of seed is about 25 kg/ha, using dry seed it is 50 kg and by broadcasting still more.

Sowing should be by drilling or by hand with rows 12-15 cm apart and rows 12-15 cm wide, corresponding to 65 to 100 plants per sq. metre. A density of about 600,000 stems per ha (250,000 per feddan) should be preferred. Sowing by hand should be as follows:
a. A measuring lath of two metres should be laid down along both short sides of the seed-beds. Every 15 cm should be indicated by a small stake (row distance). Afterwards a rope 25 metres long should be laid down between the first two stakes. In the rope every 15 cm is indicated by a knot (distance in the row). At every knot a small hole must be made and afterwards in each hole the sower should place two germinated seeds from a small basket and finally the holes must be covered. When a seed-bed of \(2 \times 25 \text{ m} = 50 \text{ m}^2\) has been sown the seed-bed should be irrigated to wet the soil. Advantages: saving of seed, quick uniform development of the plants, easier control of weeds, no thinning is required. Disadvantages: laborious, slow planting.

b. Drilling the seed by a special seed drill, precision drill John Deere, Illinois (USA) which drops seeds every 15 cm in rows of 15 cm apart. Advantages: regular rows of plants, speed sowing, lower costs of sowing. Disadvantages: higher quantities of seed, slower sprouting, less uniform development of the plants, more irrigation water, thinning of the seedlings necessary.

c. In Egypt Kenaf is sown by hand on top of both sides of a ridge with 14 ridges 50 cm apart in seed-beds of about 7 m wide and 4 to 5 m long. This is a rather laborious seeding though irrigation between the ridges is easy.

Rows more than 15 x 15 cm give coarse plants, which are difficult to ret, especially at the lower end of the stems. They give a low percentage of fibre of poor, coarse quality. The most suitable thickness of a stem should be about a finger, 1-2 cm diameter. Disinfection of the seed, with liquid mercury products by drilling the seed should be preferred and certainly a good quality of sowing seed is the foundation for a good crop.

4. Date of sowing

According to daylength, temperature and crop rotation, sowing in Egypt should not start before April and should be finished by mid of May.

5. Crop rotation

If possible kenaf should be grown after berseem or fescue, because kenaf grows well on a soil rich in organic matter. In practice however, it is only possible to sow it after a crop harvested in March if sowing starts early in April or after flax, barley or wheat if sowing starts later on. Otherwise the rotation is a question of the farmer's experience and economy.

6. Application of fertilizers

If the soil is poor in organic matter manuring with cowdung, or rotted green matter is indispensable to keep the soil in a good condition. Moreover the use of fertilizers is always strongly recommended. Kenaf requires much nitrogen and phosphate and if the potash value is low, potash also.

An average rate of 30 kg N/ha as calcium nitrate or calcium ammonium nitrate and 200-300 kilogramme per ha of 19% superphosphate is advisable. Also compound NPK-fertilizers (100-200 kg/ha) can be applied, if potash is needed. However too much nitrogen gives a low percentage of fibre, later maturing, more risk for lodging and diseases. The normal practice is to apply the fertilizer during sowing by addition of a fertilizer attachment to the seed drill or broadcasting the fertilizers by machines just before sowing, at the same time.
7. **Weed and pest control**

If the land is properly prepared and the seed planted immediately after the last harrowing, the kenaf will at the normal density of about 100 plants/m² mostly outgrow any weeds that appear and eventually choke them out. However, in certain areas pigweed (Amaranthus graecisan), Lipidium sativa, Lolium rigidum and especially morning glory (Ipomoea ramoni) can become dangerous and must be handweeded rigorously in the first 30 to 40 days. As for more crops also kenaf has its fungal-diseases, but seed treatment and normal growth, good crop-rotation, well drained soils and culture of disease-resistant varieties, normally avoid serious attacks from diseases. There are a number of insects as small black beetles (Nisotra sp.), caterpillar sp. (Nephasia), nematodes, ants and mites who can ravage considerable areas practically in some days. A good control in the field and immediate spraying with products as dieldrin, parathion, lindane, chlor dane depending on the kind of insects at the first occurrence, can practically eliminate serious damage. The rule for pest control is: "Gouverner c'est prévoir".

8. **Varieties**

My visit to Bilbeis suggests that the UAR has in the varieties Giza 1, 2 and 3 local varieties of a good yield and quality of fibre and resistance to disease. However, it should be advisable to introduce the new varieties Cuba 108, Cuba 2032, Guatemala 45 and Everglades 41 and 71 to compare yields in varietal trials. Especially a wider spread of maturing time would favour the spreading of the harvest.

9. **Seed production**

The availability of sufficient seed of known varieties and of a high purity and quality is very important. The production of seed has to be carried out under the regular and careful control of a seed inspection service on separate fields to eliminate natural cross-fertilization and the decline in purity of the good yielding varieties.

To import seed at prices of more than E£. 1 per kg is too expensive and it can be produced more cheaply (9 Pt. per kg) in Egypt. Import of samples of seed of promising highly productive clay-neutral varieties, for local multiplication should be seriously considered. The multiplication and seed production should be carried out on central fields, at least about 10 km away from the nearest fields for fibre production. The following system gives the best results in practice:

a. Sowing in rows 40 x 40 cm or 75 x 75 cm apart to allow control of every individual plant for foundation seed

b. Sowing about a month later than for fibre production, so that flowering will then start at a height of about 1 to 2 metres and thus the seed-bolls are easy to collect by hand

c. Sometimes, when the plants still grow too long, cutting the top to stimulate branching and flowering.

d. At complete ripeness, harvesting the tops by hand cutting, after drying and threshing the tops in a normal threshing machine. The heads can also be harvested by a combine adjusted for harvesting and threshing kenaf seed-bolls. The seed production can be calculated at about 800 kg per ha.

10. **Date and method of harvesting**

Harvesting of kenaf is still mostly done by hand, though a special tractor-mounted (harvester)binder has recently become available (for instance in the Netherlands for harvesting hemp or reed). The stalks are cut as near to the ground as possible and the tips of the leaf crowns, which contain no useful commercial fibre, have also to be cut off. The stalks can be laid
down and afterwards immediately decorticated or stacked and dried. For Egyptian circumstances the stalks may be dried and then retted or, perhaps better, immediately retted fresh, in bundles by the farmer himself.

To get an optimum harvest period, if the varieties grown do not differ much in time of maturing, the first fields must be cut too early and the latest fields too late. According to these conditions harvesting will be mainly done during October. Kenaf harvested too late, gives stalks, which are difficult to decorticate and ret and give a poor fibre. One labourer can harvest about 500 m² in an 8-h. day. Kenaf stalks should be sheaved if necessary with Kenaf-twine and not by sisal-twine, to eliminate damage in the spinning mills.

11. Yield of green stalks and fibre

The average yield of green stalks per hectare can be calculated at 50 tons, which gives at an average of 5 % fibre in green matter, a fibre yield of about 2.5 ton per ha. However, fibre yields of 3 tons and more are practical by growing high yielding varieties adapted to the climatic conditions in Egypt.

12. Conclusions

Summarizing it may be concluded that growing Kenaf gives no problems in Egypt but there are still items, which after careful study and action should lead to a higher yield of a better fibre.

B. The processing of kenaf

1. Decortication

The high yield per hectare of about 50 tons has induced many investigators to try and reduce the cost of transport, to increase the harvesting capacity and to cut down the high processing-costs. The most simple way is to let the farmer with his family harvest the crop himself, ret the stems in small canals, ditches or streams and make a contract with him to deliver only the retted fibre. This especially can be done if the farmer is already experienced in retting.

However for higher productions, needed to supply a factory manufacturing sacks, the farmer has to increase his yield, capacity and quality. Therefore much research work has already been carried out to solve this problem and though and though there has been some progress, other problems still need elucidation.

Especially the retting of kenaf, to separate the fibre bundle from the central woody core and to liberate the fibre, is laborious and a time-consuming process. Another system is to centralize the retting in the factory.

If the factory does not possess an extended railway net for small rail-transport in trucks and the kenaf fields lie in a circle more than about 60 km from the factory, the kenaf should be decorticated in the field. The advantages are: less transport, the waste (leaves, woody shives, and vegetable matter from the bast) is returned to the soil where it serves as mulch and fertilizer. The "ribbons" dry quicker and can be decorticated at several places simultaneously to speed up the harvesting.

Different mobile machines have been developed, constructed and marketed, but few types have become a commercial and technical success. From my own experiences I can advise the following machines:
a. The Plantée standard decorticicator Model 200, capacity approximately one feddan per 8 hours shift or 1 ton dry ribbons, price about $6000 = E.£ 2600. The capacity of the machine depends largely on the efficiency of the feeding of the stalk bundles (top first, after the tips of leaf crowns have been cut off). Every 10 to 15 minutes the machine is moved along a short distance so as to reduce carrying of the cut stalks. The Plantée decorticicators first peel off the ribbon and afterwards com­minute the core in small pieces. The decorticicator is equipped with air-cooled diesel engines.

The bigger Senior-type has a capacity of approximately 0.7 hectare, nearly 2 feddans per 8 hours shift.

b. The délaniéreuze IRCT Berteraut 58/1, pulled by a tractor, price 22,000 N.Fr. = about E.£. 2000. Neat construction like a Citroën car, but more or less fragile in the fields.

Moreover there are the Jaeggle machines type X from Germany, the Pegoraro from Mozambique, the T-2 B from the North Atlantic Kenaf International and still other types in South America.

Yesterday I saw the improved Jaeggle models and the model developed by Mr. Khourshed himself at Bilbeis and they seem good but I have not seen them working in the field. I only think that the ribboning should take place as soon as possible after cutting, within a maximum period of two days at the most to obtain the best results (less fibre losses and practically without pieces of wood remaining in the ribbons). Most of the decorticating machines work with a set of ribboned stick rollers at different speeds.

The drying of the ribbons takes about 2 days provided it does not rain and afterwards they can be transported as slightly pressed "field bales" by packing them into wooden boxes and compressing them by one or two men walking on the bundle layers.

2. Retting

As the use of dried kenaf ribbons directly for spinning and bag manu­facturing has not been very successful (too heavy bags, low strength, quickly deteriorated) the dried fibre should be retted.

This can be carried out, if not done by the farmer himself, as follows:

1. As in Bilbeis, in long canals 150 m x 2 m x 1.60 m
2. In small tanks, excavated in the soil, 5 m x 1,50 m x 2,5 m = 18,7 m³

For a good, fast retting the floating proportion should be 1 : 13 and with 0,3 g urea per m³ of water the retting can be accelerated by about 30%. The optimum temperature of the water is about 30° C; after the first day the water should be changed.

Retting time was in practice about 1 week following this practice. After retting the ribbons have to be washed and cleaned and hanged in the sun. For washing and cleaning there are also machines available on the mar­ket. My lecture has given only a brief description of all the problems. However I hope my experiences may contribute to a further and still better development of growing and processing kenaf.

I am sure there is a good future for the kenaf fibre and with Dr. ANAS, under the supervision of Dr. MOKHTAR, you have a competent and good research team. Anyhow we will follow with interest the results of chemical retting of the green ribbons which, if successful, may cut down the still expensive costs of processing.
Dear Sirs,

Referring to your letter of 8th May 1967 we are pleased to offer you herewith a Hassia flax seed drill, model DAN, drilling width 2.00 m., 24 tubes.

In standard-equipment this drill is fitted with a feed wheel system, drill coulters with spring pressure, markers, jacks, tires 4.00 - 161, big seed hopper capacity 200 ltr with detachable emptying-box and seed rate check-device.

The machine is also fitted with a special device with which it can be lowered in operating position automatically: When lowering the power device the wheels will touch the ground first. Then the markers and the coulters will be lowered. This is to prevent that the tubes will be clogged. The pressure on the coulters can be operated centrally (with the power device) and separately.

In standard-equipment the machine will drill with all the coulters on the ground with a row-distance of 8 cm.

With special extra drill-coulters which can be placed between the normal coulters the distance between the rows can be reduced to 4 cm. In that case the seed stream will be divided already at the feed wheel from where the two streams will be conducted separately to the coulters.

The price for one "Hassia" seed drill, width 2.00 m. with 24 tubes in standard-equipment as mentioned above is nett F.O.B. Rotterdam harbour (exclusive of purchase tax) inclusive of packing for ocean shipment is Hfl 2.000,— (Hfl two thousand).

The price for one extra drill coulter for reducing the row distance is Hfl 35,— (Hfl thirty five).

For a complete seed drill as mentioned above 23 extra drill coulters will be necessary.

The price for one set (two) of coverers is Hfl 90,00 (Hfl ninety).

Runboard with back: Hfl 150,— (one hundred and fifty).

Light harrow fork type Hfl 225,— (Hfl two hundred and twenty five).

Acremeter Hfl 190,— (Hfl one hundred and ninety).

Optional equipment can be supplied on the same conditions with respect to the prices, delivery and packing.

Payment will have to take place cash against documents.

Looking forward to your news with interest, we are,

Yours faithfully,

G.W. van Driel & van Dorsten N.V.
Dear Sir,

At the demand of Mister Friederich, we are sending you enclosed a detailed offer concerning:

- 1 selfpropelling flax-pulling binding-spreading-machine, with apparatus for flax-picking-up-binding-turning and apparatus for taking off the seed (flax-rippling)
- 1 flax-scutching-aggregate of our very latest type.

For your guidance, we let you know we are specialized since more than 40 years in the manufacturing of machines for the flax-industry, that are world famous for their strong and reliable design and faultless working.

We are at your disposal for giving you all further information you would like and awaiting your further news, we are, Dear Sir,

yours faithfully,

Encl.: 1 detailed offer
OFFER CONCERNING MACHINERY FOR THE FLAX-INDUSTRY

1) Self-propelling flax-pulling-machine with apparatus for flax-picking-up-binding-turning and apparatus for taking off the seed of the flax-self-propelling flax-pulling-machine, with 4 pulling elements (pulling breadth: 1,40 m.) with Deutz-Dieselmotor, with electric equipment, with binder McCormick

BFr
285,000.-

supplement of price for:

- apparatus for spreading the flax
25,000.-

- apparatus for picking-up-binding-turning
70,000.-

- apparatus for taking off the seed
85,000.-

Packing and delivery FOB ANTWERP:

- self-propelling flax-pullingmachine with apparatus for spreading the flax and apparatus for flax-picking-up-binding-turning
20,000.-

- apparatus for taking off the seed:
7,500.-

Description of the apparatus for taking off the seed:

This apparatus is mounted on the tractor of the self-propelling flax-pulling-machine (the pullingmachine is taken off for mounting this apparatus). The flax is picked up, rippled and replaced on the ground (turned); the seedballs are practically whole that is to say they are neither broken nor cleaned. The seed is captured in pockets.

2) Flax-scutchingaggregate of our latest type of a flax-scutchingmachine with 4 drums of 4 m. length, for waterwretted flax

BFr
33,900.-

1 automatic flax-distributar, heavy type

1 double flax-breaker with 4 x 5 pair rollers, special strenghtet model (heavier shaftes; with oil seals; supplementary advancing belt; special rollers; steelen cog-wheels)

248,600.-

1 flax-scutchingmachine with 2 x 2 drums of 4 meter shaftes for transmitting with supports, bushings and pulleys + shaftes with supports, bushings and pulleys for regular advancing of "belts with links" and breaker

39,550.-

belts, including transmitting-belt

10,970.-

funnels under scutchingmachine and breaker

21,900.-

aspiration for dust above the breakers: 1 exhaueter (Ø 50 cm) + pipes

14,130.-

P.S. Pipes after the exhaueter (for instance to a room for dust: to discuss in the event of order)

1 exhaueter for tows and shives

11,980.-

the necessary pipes for aspirating the tows and the shives under the machine

18,650.-

15 meter pipes of Ø 450 mm. diameter for the derivation 2 mm

8,480.-

2 elbows 2 mm

1,250.-

1 shaker 4 m. x 1,60 m.

43,510.-

1 cyclone with support (Ø 2,50 m. - 2 mm.)

20,910.-

to carry forward

903,230.- BFr
2) Flax-scutching-aggregate (continuation)

amount brought forward 903,230,- BFr

1 exhauster for shives 10,510,-
30 meter pipes of Ø 250 mm. 10,170,-
1 elbow with divisor 1,360,-
1 cyclone for shives, with support 10,740,-
Total Belg. Fr. 936,010,- BFr

This aggregate can also be delivered with a double flax-breaker of the ordinary type of 2 x 11 pair rollers; the price of this breaker is 159,330,- BFr instead of 248,600 BFr for the machine with 4 x 5 pair rollers, special strenghtet model; (the difference of price in this event is 89,270 BFr).

Packing and delivery FOB ANWERP (complete aggregate): BFr 85,000.
Time of delivery: 3 to 4 months after the receipt of the order.
Payment: at the delivery.
Option: 2 months.
DEMAN
De 12.5.1967

Doktor RASHAD
Direktor Mokhtar
Fiber Crobs - Research - Sektion
GISA ORMAN
KAIRO (U.A.R.)
Egypt

Dear Sirs,

We refer to the inquiry from Mister Friederich (Wageningen-Holland) send by our dealers the Firm R.A. Polspoel (Koewacht-Holland) and we are very pleased to make an offer for our Flax Deseeding-, cleaning and bind-machines "DEMAN"

Execution: Special for open air use
- without dust separation
- on 4 tank-wheels (full-rubber)
- with a Fuel engine traction (Air cooled)

I) Flax Deseeding and seed-cleaning machines (combined)

<table>
<thead>
<tr>
<th></th>
<th>Type M.M.6</th>
<th>Type M.M.7</th>
<th>Type M.M.7 B</th>
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<tbody>
<tr>
<td><strong>capacity</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>(Belgian quality flax)</td>
<td>2000 kg/h</td>
<td>2500 kg/ha</td>
<td>3000 kg/ha</td>
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<tr>
<td><strong>weight</strong></td>
<td></td>
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<tr>
<td>(bruto)</td>
<td>2500 kg</td>
<td>3000 kg</td>
<td>3500 kg</td>
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<tr>
<td><strong>engine</strong></td>
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</table>
| other engines on re-
| quest (cheaper marks) | Lister type LRI | Lister SR I | Lister LR II |
|                      | 5 1/4 HP at 2500 RPM | 7 3/4 HP at 2500 RPM | 10 1/2 HP at 2500 RPM |
|                      | Air-cooled | Air-cooled | Air-cooled |
|                      | Weight: 125 kg one cylinder | Weight: 125 kg one cylinder | Weight: 200 kg two cylinders |
|                      | Starting: by hand | Starting: by hand | Starting: by hand electric: on request |
| **Maintenance**      | daily to lubricate | daily to lubricate | pre-lubricated (for 1 year) |
|                      |            |            |              |
| **Price: FOB Anvers** | 137,500 fr belg | 156,250 fr belg | 200,000 fr belg |
| **Maritime Packing** |            |            |              |
| (seaworthy case)     | 10,000 fr belg | 11,250 fr belg | 12,500 fr belg |

| **Dimensions:**      |            |            |              |
|                      | L : 4 m   |            |              |
|                      | Br : 2,50 m |            |              |
|                      | H : 3 m   |            |              |
II) Flax Binding Machines "DEMAN"

**type A - Small model**
- With two tie-apparatuses MC Cormick International
- Three supply belts
- Drive: with the Diesel engine from the Deseeding machine (Renold chain drive)
- Capacity: 2,000 at 2,500 kg/h
- 2 wheels (full-rubber)

Weight: 400 kg
Dimensions: L 2 m
Fr 1,5 m
H 1,5 m

Price: FOB Antwerp 43,750 fr belg
Maritime Packing 6,250 fr belg

**type B - Great model**
- With two tie-apparatuses MC Cormick International
- Six supply-belts
- Drive: with the Diesel Engine from the Deseeding machine (Renold Chain drive)
- Capacity: 2,500 at 3,500 kg/h
- 2 wheels (full-rubber)

Weight: 500 kg
Dimensions: L 2,5 m
Fr 2,5 m
H 1,5 m

Price: FOB Antwerp 50,000 fr belg
Maritime Packing 6,250 fr belg

III) Flax Conveyor Belt "DEMAN"
- Length: 9 m (longer on request)
- Two pneumatique wheels for transport
- Changeable height (with hand tackle)
- Special execution for Bundle transport after the Binding machine

Weight ± 1,500 kg

Price 37,500 fr belg
Maritime Packing 7,500 fr belg
CONSTRUCTIEWERKRUZEN DEMAN
Rollegemstraat 40
ST.-ELOIS-WINKEL
(Belgium)

De 12.5.1967

Packing: in seaworthy case: Dimensions L 9 m
H 2,5 m
B 2 m

Delivery: FOB Antwerp
Delay: 4 weeks
Payement: By opening a Documentary Credit to the Bank of Brussels at Courtrai

Assuring You that the orders with which You may favour us will, at all times, be the object of our greatest care and attention, we remain dear Sirs,

Yours respectfully
P.V.B.A. DEMAN
Bangkok address:
Erwin J. Sholton
Metro Court, Apt. 12
21/1, Soi Somprasong No. 2
Off Petchburi Road
Bangkok, Thailand

May 15, 1967

Dear Dr. Mokhtar,

Dr. J.C. Friederich who has been working for you in an advisory capacity on kenaf development recently, has asked me to quote you on the kenaf decorticators manufactured by Plantée Equipment Company, Incorporated.

Enclosed herein, please find pamphlets and pro forma invoices covering the following equipment:

1) Plantée Decorticator Model 200
2) Plantée Decorticator Model 300
3) Plantée Fiber Washing Machine Model 500

As far as deliveries are concerned, we can supply, subject to prior sale, the Model 200 and Model 500, ex stock Vienna, and the Model 300 within approximately three months after receipt of your letter of Credit and settlement of final details. The machines will be shipped from our factory in Vienna and any L/C should be opened in favour of the following:

"Wertheim-Werke A.G.
Postfach 192
1101-Vienna
AUSTRIA"

I understand from Dr. Friederich that you have solved all problems regarding the actual growing of kenaf in Egypt, but that you are still having difficulties in connection with ribbon decortication and retting. In this connection I would like to point out that PEC are also consultants to the kenaf industry and would be glad to render such services in Egypt. Enclosed herein, please find some documentation referring to our consulting services. You may be interested to learn that I am presently acting as Consultant to the Thai kenaf industry as well as to the jute industries in East and West Pakistan and in Iraq. In each instance we are introducing the centralised decortication and retting methods which we have been instrumental in establishing in Latin America and elsewhere.
Finally, Dr. Friederich has asked me to offer you kenaf seed. We are in a position to supply commercial quantities of the following varieties of Hibiscus cannabinus, developed in the western hemisphere; Cuba 2032, Guatemala 45 and Cuba 108. The exact price will depend upon the quantities ordered but will be, for minimum shipments of one ton of each variety, in the neighbourhood of US. $ 0.50 per pound for Cuba 108 and Cuba 2032 and US. $ 0.60 for Guatemala 45 - in each case f.o.b. Central American port of export.

I trust that the above will be of interest to you and look forward to your further news. Kindly address your reply to me here in Bangkok.

Sincerely yours,
PLANTATION EQUIPMENT COMPANY, INC.

Enclosures:
1) Pamphlets & Pro Forma Invoices
2) Documentation on Consulting Services

E.J. Sholton/msh

bc: Dr. J.C. Friederich