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Cotton research in Israel

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Research efforts are generally aimed to develop improved production technologies necessary for attaining high yield and quality on one hand, and for reducing input costs on the other hand, all of which help growers to increase their net profit. Research work and field trials are being conducted at research centers, universities, regional experiment stations, as well as in commercial fields all over the country. The whole programme is coordinated by a steering committee, the members of which come from research, Extension Service, the Cotton Board and from growers organizations. Some of the subjects taken care of will be mentioned.

I - Breeding and evaluation of varieties

Breeding is carried out at three centers. The main objects in this field are improvement of yields, quality and resistance or tolerance to certain diseases and insect pests. New locally bred strains and introduced varieties are compared in regional tests. The variety Eden 1 has been bred in the hot dry Betshean Valley and commercially introduced there ; it is marked for improved yield as well as for some good agronomic features : it improved cotton profitability in that region, that had been rather low in the past. New Pima strains, bred for *Fusarium* wilt resistance, and improved quality, look promising. They are being tested and one of them was commercially introduced in 1985.

Certain interspecific hybrid lines (*G. hirsutum* x *G. barbadense*) recently developed, give high yields (Acala level) of relatively strong and long

fibers (Pima quality). Those lines are now being studied under different irrigation and fertilization regimes ; also some ginning and spinning studies of that cotton are now being conducted.

II - Mechanization and technology

Tillage : In the last few years, efforts have been aimed at developing some new tillage equipment and systems that would not compact soil to such an extent as conventional systems do.

Development of a new dependable "Uprooter-chopper", made easier the introduction of permanent traffic lanes and precision tillage system.

Combination equipment does uprooting-chopping, residue band incorporation, chiselling and bedding by one operation carried out in autumn, immediately after harvesting. Such a system and some others have already been commercially introduced. Some have found that precious time and energy can be saved and harmful soil compaction may be avoided by shifting to such systems. The implications of the new practices on various production factors, including crop protection (Pink Bollworm and weed control) should be thoroughly studied, before introducing them on a wide commercial scale. Also a controlled traffic 6 row wide tractive frame, on which various implements can be mounted, has been developed and is being tested.

Ginning : Both growers and ginners now give more emphasis to preservation and improvement of cotton quality factors that can be affected by their behaviour. The effect of various ginning treatments on lint technological quality is now being studied.

Stickiness of Lint : Some new measures for eliminating and for evaluating stickiness of lint, are being developed and tested.

III - Weed and pest control

Certain "hard to kill" weeds (such weeds as: *Euphorbia geniculata* (Mexican Spurge), *Xanthium* (Cocklebur), *Abutilon Theophrastii*, *Datura* spp. (Jimson weed) have been spreading in the last few years. The seed of some of them persist in the soil for years and germinate even from relatively deep layers. Certain new methods that have been recently developed by research, proved to control some of the weeds more efficiently as compared to what has been up to now. The biology and control of troublesome weeds is however still being treated in research. Growers sometimes still fail to obtain good enough weed control of conventional weeds too, under certain soil and weather conditions, or under some of the new production methods. Research efforts are aimed to solve such problems and also to cut costs of control. Examination of combinations of mechanical and chemical measures are being carried out. Also methods for early evaluation of weed populations are being developed. Another subject that is being treated is:

Insect control : Insect control is still considered a factor of major importance in cotton growing and therefore considerable budgets and efforts are being devoted to it.

Chemical control : New insecticides are being tested in both laboratory and field trials. Some insecticide and mineral oil combinations are being tested for their synergistic effects and efficiency against certain insects.

Determination of resistance levels developed by various field-collected strains of various insects to insecticides widely used, is being carried out, so as to trace any resistance build-up as early as possible.

Detailed studies on some cotton insects (such as *Heliothis*, the "White fly", *Prodenia*, spider-mites) and how they affect plant and yield development at various stages, have been carried out. The data collected enable building of insect-plant models. By using such models improved - dynamic treatment thresholds adapted to any combination of plant-environment-insect situation, may be arrived at. An *Heliothis* model, that has already been developed, is now being used semi-commercially.

Biological control : Introduced mass reared parasites of white fly are being evaluated for their control efficiency. Locally developed *Bacillus turingiensis* and introduced strains have been tested against "*Prodenia*" with promising results; the method is now being tested on semi-commercial scale. Work with B.t. against other insects too, is being done.

Various sex pheromone traps are effectively used on a wide commercial scale for monitoring Pink bollworm.

Also *heliothis* and spiny bollworm pheromone traps are now being tested in research as a monitoring too. Pink bollworm, *Prodenia*, *Heliothis* male confusion by pheromones is now being tested in research.

The following subjects too are taken care of by research :

- *heliothis armigera* and its chemical control ;
- aphid control ;
- examination of a method for estimating survival of the Tobacco whitefly (*Bemisia tabaci*) nymphs, after insecticide treatment ;
- development of a method for predicting the building-up of the Tobacco Whitefly population ;
- application of insecticides for the control of the early stages of the whitefly ;
- effects of sublethal doses of pyrethroids on the reproduction of the spiny bollworm ;
- study of spidermite cotton relationship ;
- study of development of cotton insect pests and their enemies in a biological field - grown without use of insecticides ;
- survey of insects and "beneficials" in cotton and preparation of an illustrated key to identification of cotton insects.

IV - Diseases

Fusarium wilt (*Fusarium oxysporum* f. SP. *Vasinfestum*) infest Pima S-5 in the north. Solar oil treatment is most effective in controlling the disease, but it is not applied in cotton on a wide commercial scale. It seems that in the short run, a solution to the problem would be planting the new *Fusarium* wilt resistant varieties, that have already been commercially introduced.

Alternaria macrospora may cause considerable damage to Pima S-5. It has been found that a yield increase of up to 1,000 kgs per ha (seed cotton) may be gained by proper fungicide treatments. That control method has already been applied on a wide commercial scale.

Nematode (*Meloidogyne incognita*, *Rotylenchulus reinformis*) infested area is still small but is spreading out and considerable potential nematode damage should be taken in account, so as to justify the research done on the subject. Some other subjects now treated in research are : *Alternaria in Acala*, seed-borne diseases, study of bollrots, examination and identification of factors in the soil that cause pathogenic symptoms in cotton.

V - Irrigation

The cost of water is high and the supply is usually limited, therefore every effort is made to improve irrigation efficiency, to increase the grower's profits from irrigation and to make work easier for him. Much has already been achieved in research and the know-how and irrigation technology developed have been extended and successfully applied by cotton growers, but more progress in that field is still needed.

Some of the subjects treated now in research are : studies aimed at improvement and comparison of various parameters, methods and instruments for monitoring and controlling irrigation including the following and some others :

- use of phenological monitoring and of an applicative irrigation model ;

- use of electrotensimeters monitoring drip and subsurface drop irrigation in an intensive production system ;
- development of automated monitoring of irrigation indicators and adaptation to irrigation computers ;

- studies of water-soil-plant relations and water-management in linear move irrigation systems, under various climatic and soil conditions ;
- use of brackish-sodic, or sewage water and effect on soil and on cotton production ;
- studies of soil fertility and fertilization, and of cotton yield decline, taking place under certain conditions ;
- removal of stalks and roots from cotton fields and the effects on the following growth and yields of cotton ;
- increasing yields of cotton, irrigated with brackish-sodic water, by decreasing inter-row spacing.

VI - New production methods

For attaining the best results in producing cotton, an optimal supply of water and nutritional elements and **enough solar radiation** is necessary. But an efficient utilization of the various elements might not be achieved if plant vegetative growth and fruit formation are not well-balanced. One of the methods recently tested is aimed at reaching such an optimal balance for late planted cotton that in past years gave only very poor results. In experiments and now also on a commercial scale, such cotton, that was planted at the end of May, after a yield of 5,000 kg/ha wheat for grains had been harvested, gave very high cotton yields at the end of October. Water has been applied daily by very small drip irrigations.

Such a late planting makes double-cropping feasible. The growing period is then shortened and the input costs lower than usual. The yields achieved have been high per both area and water units.

VII - Development and trial of models

Cotton production is a dynamic system in which various plant and environmental factors take part and mutually affect each other. Conditions in the

system continuously change, and therefore, field operations should always be adapted to the changing situations.

Predetermined work lines might be helpful for planning purposes, but would not be sufficient for ensuring the best production results possible.

Cotton models, simulating plant growth and fruit formation, "partial" models like Irrigation, Fertilization, Insect (*Heliothis* and others), Prediction of Boll Opening Rate Models and others are being developed or improved.

Such research work is aimed at attaining a broader, deeper understanding of cotton growth and yield formation processes, and so also unable an improved planning of cotton research, the final objects of which is developing better field management tools that would help to improve production efficiency.

Very detailed plant monitoring and intensive field data collection is carried out in a few representative plots in almost each one of the regions.

The data, systematically collected throughout the season, is fed into programmed computers, processed and analyzed. The information received,

particularly that on plant growth and yield forming curves, is studied by researchers and extension staff and usually also compared to curves of previous seasons. In certain districts, up-to-date information collected is passed on to and discussed with producers. Extension personnel then try to trace any trend in plant growth and yield formation, that would be of special interest, and probably necessitate changing of pre-planned operations.

As the information collected and analyzed is based on quantitative measurements, it is no doubt much more accurate and valuable for decision-making than that based on just general visual observations.

It should however be clear, that the data supplied from sub-regional **representative** plots, is for providing additional information to that collected in the growers specific fields, and is by no means supposed to replace it.

Though models are still being developed and improved, there is still much work to do on the subject. However, partial commercial use of certain models has in fact already been started and in the years to come, more and more models and computers will be used for making production more efficient.