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Preliminary studies on plant profile and population dynamics of insect pests of cotton

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Summary

Some studies on plant profile and population dynamics of insect pest of cotton at C.R.I. Sakrand were carried out. The results are summarised as under.

1. The critical period of plant growth was defined to be eight weeks starting from first week of July upto fourth week of August. Peak square formation started from first week of July and ended upto first week of September while the flowering started one week after the square formation stage. Critical boll formation period was defined to be 9 weeks from 2nd week of August to 2nd week of October thus the July flowers did not set any boll. The critical period of crop protection was defined to be 2nd week of June and 2nd week and 3rd week of August for sucking complex. For borer complex, Ist week of September was found to be optimum for spraying in view particular pest population dynamics build-up.

2. The population dynamics of major pest and their natural enemies were studied. The jassids, thrips and white flies activities remained maximum from Ist week of June to 4th week of August; where as the same for natural enemies were from August to October. Similarly the spotted and pink boll worm started from Ist week of August and September to 2nd week of October and November, respetively.

Introduction

Sind province is the ancient home of cultivated cotton. Cotton was grown in the Indus valley as early as 3000 BC (2). Cotton is popularly known as silver fibre and seems to have occupied the most important position in Sind eversince and is the most important cash crop even today.

Sind Province enjoys warm sunny climate and is well suited to cotton cultivation. There are vast possibilities of accelerating cotton production in the province. Besides, proper plant husbandry and retioning with proper

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fertilizer nutrient management, the plant profile and incidence of insect pest attack also plays a very key role in cotton production.

Cotton plant has got its own characters for development, viz., budding, flowering, boll-forming and maturing etc. The kinetics of these developmental characteristics of a variety are collectively known as plant profile. Similarly, the insect population is also influenced by a number of factors. Thus the fluctuation in the population of an individual insect, under the influence of prevalent bio-ecological forces is known as population dynamics.

Evergreenness of the Sind provides considerable opportunities to insect fauna to be epidemic to the field crops. To become aware and combat insect pest menace it is necessary to know their population dynamics in order to undertake necessary, but timely control measures.

Keeping the objectives of insect population development in relation to plant profile in mind, some preliminary studies on these lines were carried out in order to develop effective pest forecast system and workable strategy for timely control recommendations.

Material and methods

An isolated cotton field of five acres (variety Qalandri) was selected at Cotton Research Institute Farm Sakrand. The sowing date of that block was 18th May 1979. Recommended cultural operations of weeding, hoeing, irrigation and fertilizer application etc. were given to the crop as and when required. Sampling method developed by UNDP experts at Cotton Research Institute Multan for pest scouting was adopted. It is mainly based on measuring four basic components, i.e., plant profile, pest population, pest damage and presence of beneficial insect in that sample unit. The sample unit consisted of four sampling points selected at random; each one comprising of a segment of a row which was 52.25 inches long totalling to 209 inches (for all the four points) which becomes equivalant to 1/1000 of an acre.

Weekly pest population observations were recorded in these sampling units selected in the field. In all, 20 leaves per plant alternately from upper, middle and lower foliage were examined and total number of adults and nymphs of iassid, white flies and thrips were counted and recorded. In addition, total number of natural predators and pest parasites per plant were also recorded in all those plants covered in a sampling unit described above. The total number of fruiting parts, viz., buds, flowers, immature, mature and open bolls per plant per sampling unit were also recorded. From these, the damaged fruiting parts (characteristics of the pest) per plant were separately noted. Finally, average plant height per sampling unit was also

recorded. For the purpose of illustration, pest scouting in a sampling unit is explained in Figure-1.

Results and discussion

Plant profile : The results of plant profile studies are summarised in Table-1. It is quite indicative from the Table that the vegetative growth of the crop reached its maximum in the 3rd week of August with an average height of 51.37 inches. The square formation started in the 3rd week of June and reached its peak in the 4th week of July, while flowering stage initiated in the Ist week of July and reached its peak in the 3rd week of August. The boll formation started from last week of July and then the maximum number of mature green bolls were recorded in the 4th week of September where as the maximum opening was observed in the Ist week of October. It may also be mentioned overhere that the flowers formed during the month of July mostly got shed as the boll formation started in the first week of August. Our April sowing experiments also confirm this, as most of the flowers formed during June and July in those experimental plots get shed down as the boll formation only started in the first week of August.

— Population dynamics studies

a) Sucking complex : The climate being conducive to pest prevalence, the intensity and magnitude of cotton insect pest complex in Sind is considerably high and has taken the position of a serios nature. It seems that little efforts have been made to meet this challange. Since last year, some studies have been carried out at the institute on the incidence and abundance of some important pests of cotton and their natural enemies. The over-all population of sucking complex is shown in Table-2 and their graphic representation is explained in Figure-2 and 3. The results are discussed under different pest headings.

Table - I

Plant growth and fructification pattern of Qalandri in an isolated field of five acres at Cotton Research Institute Farm Sakrand during the year 1979-80.

Months/ Weeks	Average plant height in inches	Squares	Flowers	Mature green bolls	Open bolls
May, 79					
4th week	3.25	0	0	0	0
Average	3.25	0	0	0	0

Table - I (Continued)

Months/ Weeks	Average plant height in inches	Squares	Flowers	Mature green bolls	Open bolls
June, 79					
Ist week	8.75	0	0	0	0
2nd week	9.55	0	0	0	0
3rd week	11.16	25,000	0	0	0
4th week	13.54	315,000	0	0	0
Average	10.75	85,000	0	0	0
July, 79					
Ist week	19.70	445,000	35,000	0	0
2nd week	24.10	585,000	40,000	0	0
3rd week	30.55	1250,000	55,000	0	0
4th week	33.97	1475,000	65,000	25,000	0
Average	27.08	938,750	48,750	6,250	0
August, 79					
Ist week	45.50	1470,000	150,000	150,000	0
2nd week	46.75	1160,000	160,000	960,000	0
3rd week	51.37	1355,000	170,000	575,000	30,000
4th week	40.00	1375,000	125,000	645,000	75,000
Average	46.91	1340,000	151,250	582,500	26,250
September, 79					
Ist week	45.00	870.000	70.000	415,000	405,000
2nd week	45.00	350,000	110,000	775,000	380,000
3rd week	50.25	405,000	30,000	505,000	685,000
4th week	45.25	430,000	60,000	1165,000	580,000
Average	46.37	513,750	67,500	715,000	512,500
October, 79					
Ist week	50.00	215,000	10,000	675,000	1460,000
2nd week	48.00	180,000	25,000	510,000	1350,000
3rd week	46.00	175,000	20,000	195,000	1310,000
4th week	48.50	80,000	0	145,000	120,000
Average	48.12	162,500	13,750	381,250	1060,000
November, 79					
Ist week	48.00	340,000	40,000	60,000	225,000
2nd week	46.62	315,000	35,000	60,000	835,000
Average	47.31	327,500	37,500	60,000	530,000

Table - II

Population dynamics of sucking pests in an isolated field of five acres at Cotton Research Institute, Sakrand Farm, during the year 1979-80.

(Average insects population per leaf)

Month/ Weeks	*E.devastans*	*T. tabaci*	*Scirtothrips dorsalis*	*B.tabaci*	*T.telarius*
May, 79					
4th week	0	0.02	0	0.02	0
Average	0	0.02	0	0.02	0
June, 79					
Ist week	0.05	0.15	0.02	0.15	0
2nd week	0.15	0.02	0.15	0.01	0
3rd week	0.01	0.02	0.15	0.04	0
4th week	0.25	0.35	0.15	0.40	0
Average	0.12	0.14	0.12	0.06	0
July, 79					
Ist week	0	0	0.40	0.15	0
2nd week	0.15	0.10	0.75	0.16	0.15
3rd week	0.10	0.10	1.65	0.45	0
4th week	0.35	0.10	4.30	0.05	0.40
Average	0.13	0.08	1.62	0.70	0.55
August, 79					
Ist week	0.65	0.20	1.50	0.00	0
2nd week	0.65	0.00	0.30	0.30	0
3rd week	0.75	0.35	1.00	0.05	0
4th week	2.45	2.00	2.00	0.35	0
Average	1.13	0.59	1.20	0.11	0
September, 79					
Ist week	0.90	0	0.65	0.30	0.10
2nd week	2.00	0	0.85	0.16	0.15
3rd week	1.05	0	0.60	0.25	0
4th week	1.55	0	0.70	0.40	0.15
Average	1.77	0	0.41	0.10	0.00
October, 79					
Ist week	0.75	0	0.55	0	0.90
2nd week	0.90	0	0.40	0.40	0.50
3rd week	0.60	0	0.50	0.25	0.45
4th week	0.75	0	0.50	0.25	0.40
Average	0.41	0	0.17	0.14	0.16

Table - II (Continued)

Month/ Weeks	*E.devastans*	*T. tabaci*	*Scirtothrips dorsalis*	*B.tabaci*	*T.telarius*
November, 79					
Ist week	0.35	0	0.40	0.25	0.40
2nd week	0.20	0	0.50	0.10	0.35
Average	0.10	0	0.45	0.13	0.19

(i) Cotton jassid *(Empoasca devastans* Dist.)

Jassid is a serious pest of cotton in this province and destroys the crop by sucking the sap from the leaves and some times tender parts of the plant. During the course of study, its first appearance was recorded in the Ist week of June, while the maximum population of 2.45 jassids per leaf was recorded in the 4th week of August and remained active upto economic injury level till 4th week of September and thereafter, the population started declining. Present observations indicate that the pest population reached its peak when the flowering stage of the plant was also on its maximum. Similar observations were also recorded at ARI, Tandojam in 1972 that the pest was active in the crop throughout the season but its peak population built up in June to July in the central Sind, while its maximum damage was observed in July and August in Northern Sind. The peak population of 5-10 nymphs per leaf was recorded in July-August months (4).

The relationship of jassid population buildup with maximum and minimum temperature is given in Figure-2. The figure indicates direct correlation between the two variables specially in the economic threshold level (period) of the pest.

(ii) Thrips

Black thrips *(Thrips tabaci* Lind.) appeared in the 4th week of May and the highest population of 2.0 thrips per leaf was recorded in the 4th week of August. Yellow thrips *(Scirtothrips dorsalis* Hood) appeared in the Ist week of June, and their maximum population of 4.3 thrips per leaf was recorded in the 4th week of July. Thus only two species viz; black and yellow thrips were active in cotton field. The black thrips starts damaging the crop from the time of germination and continues upto 4th week of August. The yellow species which is more serious pest, remained active from the time of germination to the harvest and is responsible for inflicting heavy losses to the crop particularly in Nawabshah District. The maximum damage was done to the young crop.

The population was higher in hot and dry conditions when the environmental temperature was also high (Fig.-2). No systematic work on their distribution, bionomics and predators and parasites seem to have been done under Sind conditions.

(iii) White flies *(Bemisia tabaci* Genned)

White-fly is also a sucking pest and appeared in the 4th week of May, and their maximum population of 0.45 flies per leaf recorded in the 3rd week of July. Generally, the population of white flies seem to be correlated with the increase in temperature and the population is maximum in dry months of May and June when the temperature is about 42°C to 43°C. In the present studies, the population of the pest remained mostly below the economic injury level but that too was associated with the temperature fluctuations. However, detailed systematic work is needed to be carried out to find out the extent of damage, critical level of infestation and bionomics of the pest.

(iv) Two spotted mite *(Tetranychus telarius* L.)

It is a non insect pest and appeared in the 2nd week of July and their maximum population of 0.45 mites per leaf was recorded in 3rd week of October. The data from Table-2 revealed that the population of mites remained below the economic injury level. Similarly it was noted that the out-break of this pest was frequent in the areas treated with chlorinated hybrocarbon (Toxophane, Endrin, DDT) and carbonated (sevin) groups of pesticides (3).

b) Boll worm complex

(i) Spotted boll worm (*Earias* sp.)

It is a major pest of cotton in Sind province. The spotted boll worms made their appearence in the first week of August on tender shoots. The maximum population of 7000 worms per acre on bolls was recorded in the Ist week of September (Table-3). Infestation was relatively more on the bolls as compared to buds. Similar results were also recorded by previous workers in which it was mentioned that the attack in bolls was generally higher than in buds and during August-September the attack was at its maximum (1).

(ii) Pink boll worm *(Pectinophora gossypiella* Saund.)

During the course of study, it was observed that the pest first apperared in the last week of August and reached its peak of 3000 worms per acre twice, first in the 2nd week of September and second in the 2nd week of November (Table-3).

Table - III

Alive Bollworms larvae collected in an isolated field of five acres at Goverment Farm Sakrand, during the year 1979-80.
(Population per five acres)

Months/Weeks	Spotted	Pink	Total
May, 79			
4th week	0	0	0
Average	0	0	0
June, 79			
Ist week	0	0	0
2nd week	0	0	0
3rd week	0	0	0
4th week	0	0	0
Average	0	0	0
July, 79			
Ist week	0	0	0
2nd week	0	0	0
3rd week	0	0	0
4th week	0	0	0
Average	0	0	0
August, 79			
Ist week	5.000	0	0
2nd week	15,000	0	0
3rd week	30,000	0	0
4th week	10,000	5,000	0
Average	15,000	1,250	0
September, 79			
Ist week	35,000	10,000	45,000
2nd week	10,000	15,000	25,000
3rd week	10,000	10,000	20,000
4th week	10,000	5,000	10,000
Average	16,250	10,000	25,000
October, 79			
Ist week	10,000	5,000	15,000
2nd week	15,000	10,000	25,000
3rd week	0	10,000	10,000
4th week	0	10,000	10,000
Average	2,250	8,750	11,000

Table - III (Continued)

Months/Weeks	Spotted	Pink	Total
November, 79			
Ist week	0	10,000	10,000
2nd week	0	15,000	15,000
Average	0	3,750	3,750

c) Natural enemies

While studying the populaton dynamics of the insect pests of cotton, some natural enemies of the pests are generally recorded. This is because the natural enemies act as parasites and predators of the cotton pest complex and help in reducing the population level so that if the economic threshold level of a particular pest is not attained spraying recommendations become unadviseable, impracticable and uneconomic. The observations on the appearance and population levels of parasites and predators were noted and are presented in Table-4. Species-wise discussion and their respective population development is given under separate headings.

(i) *Chrysopa*

In the present work it was observed that *Chrysopa* sp. made their appearance in the Ist week of August, their maximum population of 3000 specimen per acre was recorded in the 4th week of August.

(ii) Coccinelid beetles

The beetles first appeared in the 4th week of May and the maximum population of 12000 beetles per acre was recorded in the 3rd week of October.

(iii) *Orius* bugs

The first appearance of *Orius* bug was recorded in the 2nd week of June where as the maximum population of 8000 bugs per acre was recorded in the 2nd week and 4th week of September and October, respectively.

(iv) Spiders

The spiders made their appearance in the 4th week of May. The population reached the maximum level of 4000 spiders per acre in 2nd week of October.

Table - IV

Population dynamics of predators of cotton pests in an isolated field of five acres at Goverment Farm Sakrand during the year 1979-80.

Months/ Weeks	*Chrysopa*	Spotted beetle	*Orius* bug	Spider	Ant	Total
May, 79						
Average	0	15,000	0	5,000	0	20,000
4th week	0	15,000	0	5,000	0	20,000
June, 79						
Ist week	0	15,000	0	5,000	0	20,000
2nd week	0	35,000	15,000	10,000	25,000	85,000
3rd week	0	15,000	10,000	5,000	10,000	40,000
4th week	0	20,000	5,000	5,000	20,000	50,000
Average	0	21.250	7,500	6,250	13,750	48,750
July, 79						
Ist week	0	15,000	5,000	5,000	0	25,000
2nd week	0	30,000	0	5,000	0	35,000
3rd week	0	25,000	5,000	10,000	0	40,000
4th week	0	20,000	15,000	10,000	25,000	70,000
Average	0	22,500	6,250	7,500	6,250	42,500
August, 79						
Ist week	5,000	0	80,000	10,000	10,000	105,000
2nd week	10,000	5,000	35,000	10,000	15,000	75,000
3rd week	5,000	10,000	35,000	0	0	45,000
4th week	10,000	40,000	25,000	10,000	0	85,000
Average	8,750	13,450	43,750	7,500	6,250	74,700
September, 79						
Ist week	5,000	25,000	15,000	0	0	35,000
2nd week	0	45,000	40,000	15,000	0	100,000
3rd week	0	10,000	10,000	0	0	20,000
4th week	0	0	0	0	0	0
Average	1,250	20,000	16,250	3,750	0	40,000
October, 79						
Ist week	0	10,000	0	6,000	0	16,000
2nd week	0	50,000	35,000	20,000	0	105,000
3rd week	0	60,000	0	15,000	30,000	105,000
4th week	0	55,000	40,000	15,000	25,000	135,000
Average	0	43,750	18,750	14,000	13,750	90,250

Table - IV (Continued)

Months/ Weeks	*Chrysopa*	Spotted beetle	*Orius* bug	Spider	Ant	Total
November, 79						
Ist week	0	15,000	0	5,000	0	20,000
2nd week	0	0	0	10,000	0	10,000
Average	0	7,500	0	7,500	0	15,000

(v) Ants

During course of study it was observed that ants are also predacious to some pests; their appearance was first noted in the 2nd week of June and the maximum population of 6000 ants per acre was recorded in the 3rd week of October.

These were some general observations on the natural enemies of the cotton pests. During the course of study, none of the predator was observed in actual predating form. However some constructive work on the bio-ecological aspects of these predators and parasites of pests is needed to be studied.

Figure-3 indicates that the population of sucking complex developed its peak from 3rd week of June and continued upto 4th week of August, from where it started to decline. Correspondingly, the population of natural enemies reached the peak on different times i.e., Ist and 4th week of August, 2nd and 4th week of September, 3rd and 4th week of October and 2nd week of November. While comparing the peak populations of pests and their predators, it was observed that when the population of sucking pest complex was at its maximum, the population of their natural enemies was not to the extent to which it could control the sucking complex. At this stage, chemical control measures are recommended and must be taken. Keeping in view the insect population development, it was concluded that two sprays must be done, first, in the 2nd week of June and second, in the 2nd-3rd week of August for sucking complex. In case of bollworms, one spray in the Ist week of September is recommended.

As these our preliminary studies on this aspect, these spray recommendations hold good for Sakrand and its vicinity areas. The confirmation of these spray recommendations will be treated in next year's population dynamics studies, and depending upon the available facilities, we will extend these studies to cotton maximization project areas of Hala and Sakrand Tehsils also.

Özet

Pamukta zarar yapan böceklerin populasyon dinamikleri üzerinde ilk araştırmalar

Bu çalışmada C.R.I. Sakrand (Pakistan)'da zarar yapan böceklerin populasyon dinamikleri bitkinin değişik gelişme dönemlerine göre incelenmiş ve elde edilen sonuçlar aşağıda gösterilmiştir.

1. Pamuk gelişmesi için kritik periyot temmuzun ilk haftasında başlayıp ağustosun son haftasına kadar devam eden 8 haftalık periyod olarak bulunmuştur. Maksimum tarak oluşumu temmuzun ilk haftasında başlayıp eylülün ilk haftasında sona ermekte, buna karşılık çiçeklenme tarak oluşumundan bir hafta sonra başlamaktadır. Kritik koza oluşum periyodu ise 9 hafta olup ve ağustosun 2. haftasından ekimin 2. haftasına kadar sürmektedir. Fakat temmuz çiçeklerinden koza oluşmamaktadır. Sokucu emici böceklerle savaş için kritik zamanın temmuzun 2. haftası ve ağustosun 2. ve 3. haftası, buna karşılık **Earias** sp. ve **Pectinophora gossypiella** için eylülün ilk haftası olduğu saptanmıştır.

2. Bu çalışmada ayrıca önemli pamuk zararlıları ve bunların doğal düşmanlarının populasyon dinamikleri üzerinde de çalışılmıştır. **Empoasca devastans**, **Thrips tabaci, Scirtothrips dorsalis** ve **Bemisia tabaci**'nin populasyon düzeyi haziranın 1. haftası ile ağustosun son haftası arasında maksimuma ulaşmıştır.

Buna karşılık bunların doğal düşmanları ağustostan ekime kadar bol olarak bulunmuştur. **Earias** sp. ağustosun ilk haftasından ekimin ikinci haftasına, **P. gossypiella** ise eylülün ilk haftasından kasımın 2. haftasına kadar olan zaman içinde en yüksek populasyon düzeyine ulaşmaktadır.

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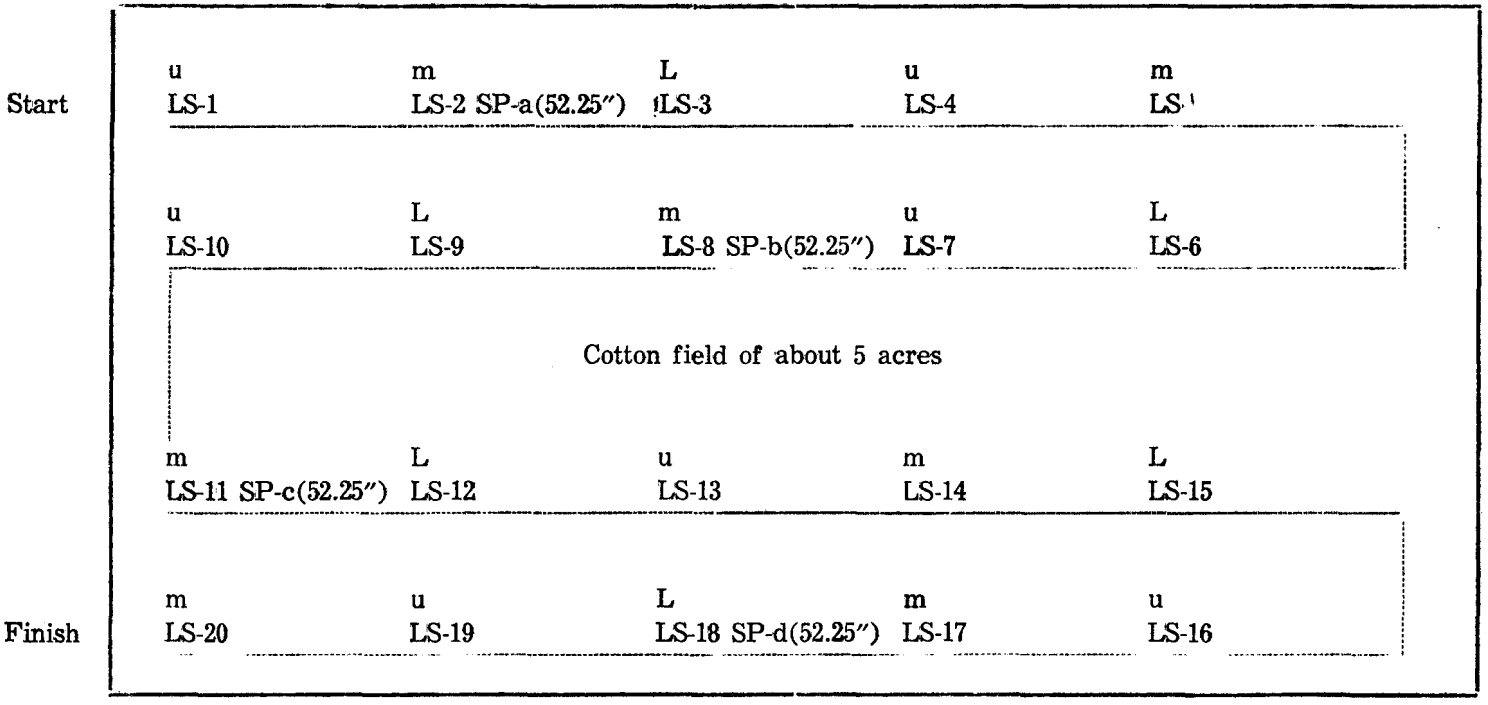
Fig. 1. Pest scouting sampling method followed in a cotton field of five acres.



LS = Leaf Sample No.
SP = Sample Point

u = Upper leaf sample
m = Middle leaf sample
L = Lower leaf sample

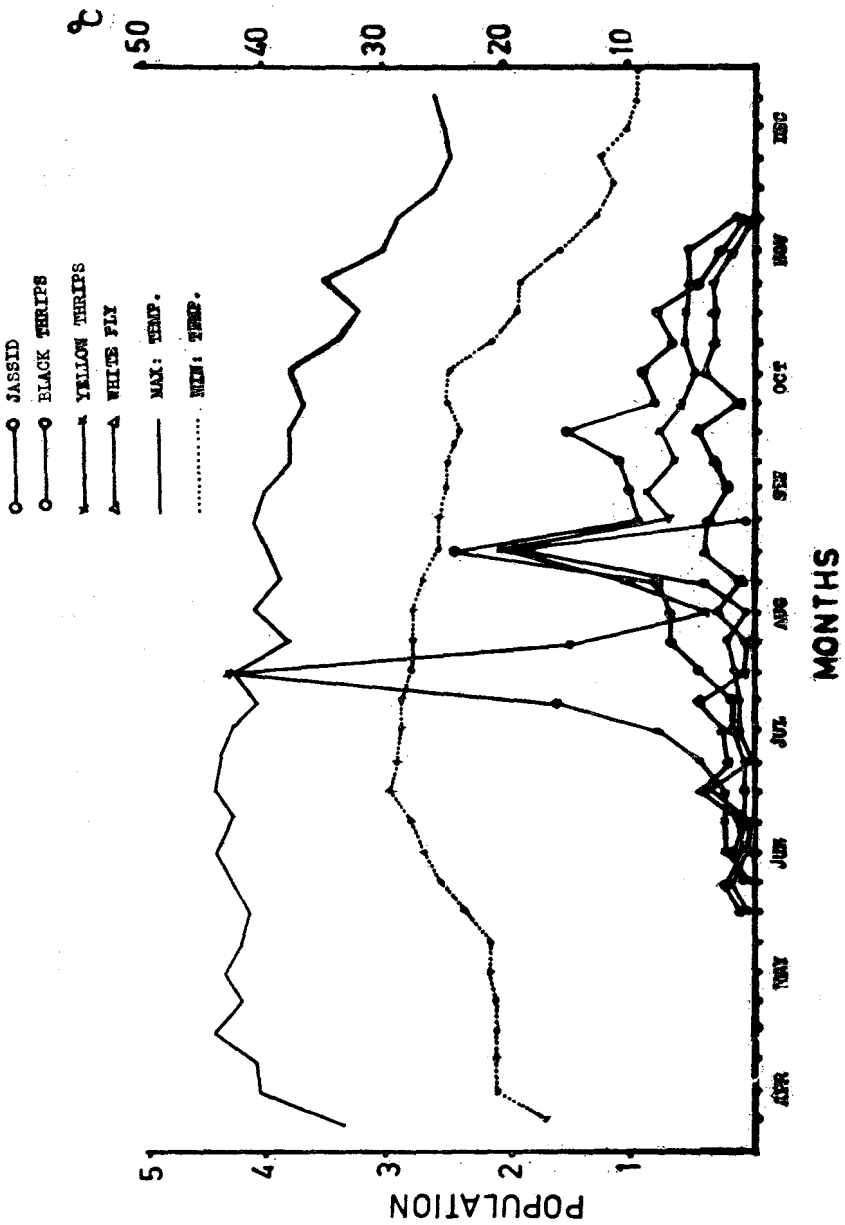


Fig. 2. Population dynamics of sucking pests of cotton in an isolated field of five acres at C.R.I. Farm Sakrand during the year 1979-80.

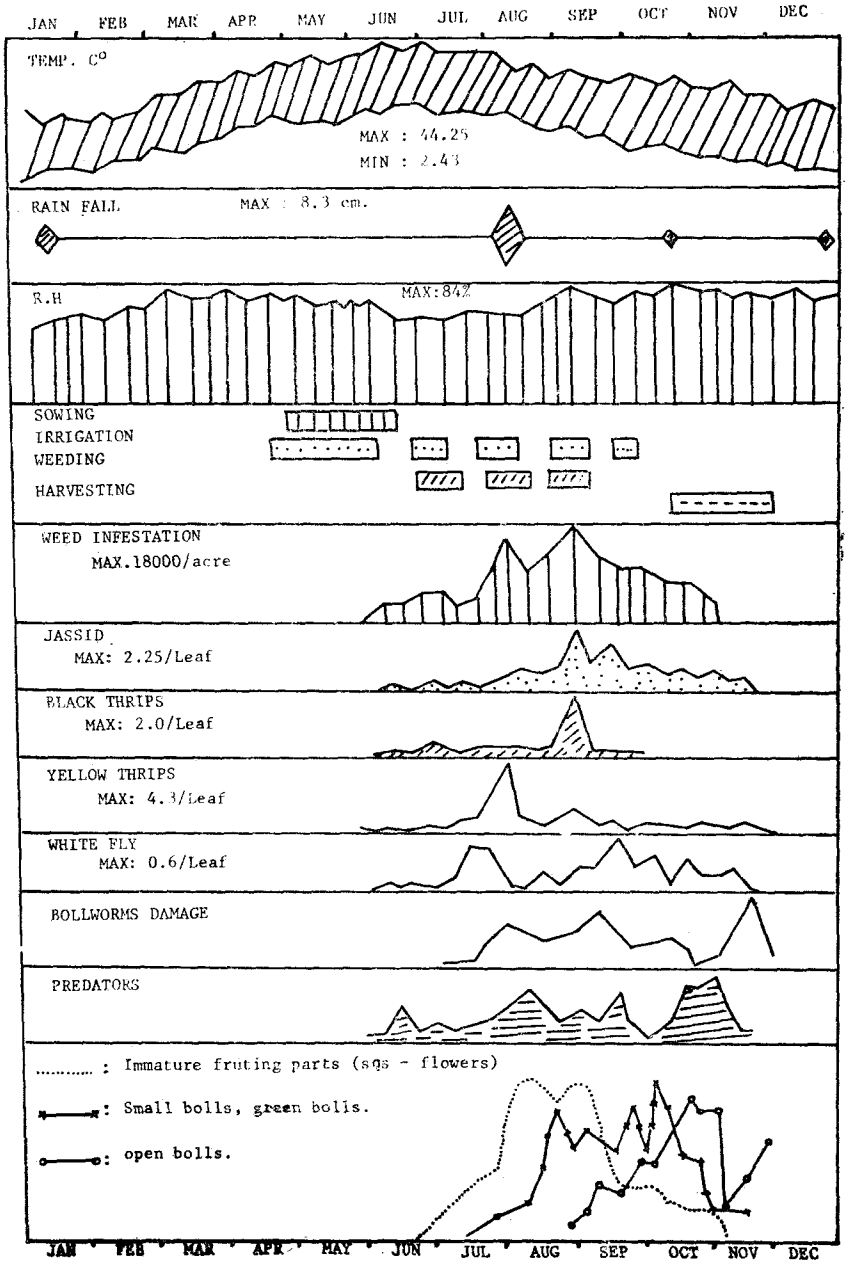


Fig. 3. The cotton agro-ecosystem in the Sakrand (Sind).