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A CASE STUDY

Phyto-sociological studies of sugarcane crop and its weed communities

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SUMMARY

Weed communities of sugarcane crop were determined by using quadrate method at three different sugarcane growing localities of District Meerut, during 2009-10. A total of 14 weed species distributed across 12 families were recorded. Among all weeds, *Gnaphalium luteo-album* had the highest average density (21.5/m^2). Three species were dominant, *i.e. Gnaphalium luteo-album* (21.5/m^2), *Antirrhinum majus* (8.5/m^2) and *Trigonella foenum-graecum* (2.2/m^2). In the present study, these three species were concluded as the most competent weeds which enter into real competition with the sugarcane crop.

Key Words : Sugarcane, Quadrate method, Competent weeds

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Agriculture ecology has long been considered separate from classical ecology and conservation biological research. Focus on agricultural ecology has turned attention to the potential importance of uncropped areas of the farm (field margins, successional fallow fields, ditch systems, and neighboring forests) in an effort to understand the role of these areas playing in the agro-ecosystem (Jelinek, 2004). Plants rarely grow in isolation, whether in natural or agricultural ecosystems. Every plant is a member of a community of plants, interacting with each other through different mechanisms (Benaragama, 2011).

Weeds are constant component of agro-ecosystem (Mennan and Isik, 2003). Besides, weed competition and weed control are major limiting factors to crop production (Phillips, 1992).

Weed infestation is one of the major impediments to sugarcane yield including diseases, pests and climatic influences. They consume available moisture, nutrients and compete for space and sunlight with crop plants and result in yield reduction (Khan *et al*., 2004). They are constant component of our agro-ecosystems and are generally controlled using mechanical method (Powell and Justum, 1993). However, many seeds of exotic species are introduced in various regions accidentally and some of them may become component of natural flora of the area (Werger, 1997; Jauzein, 1998; Maillet and Lopez-Garcia, 2000).

It has long been recognized that man made activities are exposing the environment to invasion by alien species, which is attributed to habitat heterogeneity, frequent and diverse disturbances, and intensive propagule pressure typical of that environment (Gilbert, 1989; Kowarik, 2003). Weeds decrease the crop yield by competing for water, nutrients, space and light; whereas, some weeds also have allelopathic effects on crops (Shah and Khan, 2006).

Information on weed density, distribution, and species composition may help to predict yield losses and such information helps in deciding whether it is economical to control a specific weed (Kropff and Spitters, 1991).

MATERIAL AND METHODS

Sugarcane is sown from March to June and is harvested from November to March in the following year in Western

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Uttar Pradesh in India. A major sugarcane growing site (near village Pachpera, Meerut, India) was selected with three crop fields, each of atleast two acres in area. First, a preliminary survey was conducted on selected sites and the different weed species associated with the crop were collected, identified and specimens for each species were prepared. The crop-weed association was studied by quadrate of 1 meter diameter. Ten quadrates were randomly placed in each field at fortnightly intervals during the crop seasons and the number of plants of each species (crop and weeds) falling in the quadrate were carefully counted and listed. From the obtained data, different phyto-sociological parameters of weeds and crops were studied like density, abundance and frequency of each weed species. These values were computed to get importance value index (IVI) and Shanon index. Weed communities were constructed from selected study sites having highest IVI.

$$\text{Density} = \frac{\text{Total number of individuals of a species in all quadrats}}{\text{Total number of quadrats studied}}$$

$$\text{Abundance} = \frac{\text{Total number of individuals of a species in all quadrats}}{\text{Number of quadrats of occurrence}}$$

$$\text{\% frequency} = \frac{\text{Number of quadrats of occurrence}}{\text{Number of quadrats studied}} \text{x100}$$

$$\text{Important value index (IVI)} = \text{Relative abundance} + \text{Relative density} + \text{Relative frequency}$$

$$\text{Shanon index (H')} = -\sum_{pi} \text{In}\,(p_i)$$

where,

H' = The Shannon index; p_i = the relative abundance of each group of organisms

RESULTS AND DISCUSSION

Weed flora of the study area comprised of 14 species of flowering plants belonging to 12 different families. According to distribution pattern, the weeds were classified in the following categories: (i) Species found on the edges of the crop fields only- e.g. *Cannabis sativa*. (ii) Species found within the crop fields only- e.g. *Fumaria indica*, *Lathyrus aphaca* and *Vicia hirsuta*. (iii) Species found along the margins as well as within the crop field- *Coronopus didymus, Stellaria media, Anagallis arvensis, Trigonella foenum-graecum, Gnaphalium luteo-album, Antirrhinum majus, Leucas aspera, Chenopodium murale, Cyperus rotundus* and *Cynodon dactylon* were the weeds of this category.

Distribution pattern and density of weeds :

Normally, there were no weeds in the first 15 days after sowing of the crop. *Anagallis arvensis, Trigonella foenum-graecum, Gnaphalium luteo-album, Antirrhinum majus, Cyperus rotundus* and *Cynodon dactylon* appeared after 30 days of sowing of the crop but most of other weeds appeared after 45 days (Tables 2 and 3). Considerable fluctuations were observed in total weed density/m^2 at different times (Table 1). There was an increase in the weed density from 30th day to 60th day, decrease on 75th day to 105th day after sowing of the crop. These data (average for three fields) showed that there was maximum weed density when the sugarcane crop was 60 days old. This is the time when weeds enter in to severe competition with the crop. Among all weeds, *Gnaphalium luteo-album* had the highest average density (21.5/m^2). Out of 14 weeds

Table 1: Analytical characters of plant-weed association- density in sugarcane fields

Plant species	Density						
	16 May	31 May	15 June	30 June	15 July	30 July	Average
Saccharum officinarum (crop)	14.5	14.2	15.2	15.0	14.7	14.4	14.6
Fumaria indica	-	0.6	0.4	-	-	-	0.5
Coronopus didymus	-	1.4	1.4	1.5	1.2	1.0	1.3
Stellaria media	-	-	0.3	0.1	-	0.1	0.2
Trigonella foenum-graecum	2.6	2.5	2.5	2.0	1.8	1.8	2.2
Lathyrus aphaca	-	-	0.1	0.1	-	-	0.1
Vicia hirsuta	-	0.2	-	-	0.1	-	0.1
Gnaphalium luteo-album	10.6	15.6	32.4	30.1	20.5	20.0	21.5
Anagallis arvensis	0.4	0.8	1.6	1.6	1.5	1.2	1.1
Antirrhinum majus	12.4	12.0	8.4	8.0	5.5	5.0	8.5
Leucas aspera	-	0.4	-	0.2	-	-	0.3
Chenopodium murale	-	-	0.3	0.1	-	0.2	0.2
Cannabis sativa	-	2.4	-	-	-	1.5	1.9
Cyperus rotundus	1.6	1.7	2.5	2.8	1.2	1.2	1.8
Cynodon dactylon	1.3	1.6	1.8	2.0	1.8	1.8	1.7
Total	43.4	53.4	66.9	63.5	48.3	48.2	53.95

Table 2 : Analytical characters of plant-weed association- abundance in sugarcane fields

Plant species	Abundance						
	16 May	31 May	15 June	30 June	15 July	30 July	Average
Saccharum officinarum (crop)	14.5	14.2	15.2	15.0	14.7	14.4	14.6
Fumaria indica	-	3.0	2.0	-	-	-	2.5
Coronopus didymus	-	7.0	7.0	5.0	3.0	3.3	5.0
Stellaria media	-	-	3.0	1.0	-	1.0	1.6
Trigonella foenum-graecum	8.7	6.2	6.2	5.0	6.0	6.0	6.3
Lathyrus aphaca	-	-	1.0	1.0	-	-	1.0
Vicia hirsuta	-	2.0	-	-	1.0	-	1.5
Gnaphalium luteo-album	10.6	15.6	32.4	30.1	20.5	20.0	21.5
Anagallis arvensis	2.0	4.0	5.3	5.3	5.0	4.0	4.2
Antirrhinum majus	20.6	20.0	16.8	16.0	11.0	10.0	15.7
Leucas aspera	-	4.0	-	2.0	-	-	3.0
Chenopodium murale	-	-	3.0	1.0	-	2.0	2.0
Cannabis sativa	-	8.0	-	-	-	5.0	6.5
Cyperus rotundus	4.0	4.2	5.0	5.6	2.5	2.5	3.9
Cynodon dactylon	4.3	5.3	4.5	5.0	4.5	4.5	4.6
Total	64.7	93.5	101.4	92	68.2	72.7	82.08

Table 3 :Analytical characters of plant-weed association- frequency in sugarcane fields

Plant species	Frequencey						
	16 May	31 May	15 June	30 June	15 July	30 July	Average
Saccharum officinarum (crop)	100	100	100	100	100	100	100
Fumaria indica	-	20	20	-	-	-	20
Coronopus didymus	-	20	20	30	40	30	28
Stellaria media	-	-	10	10	-	10	10
Trigonella foenum-graecum	30	40	40	40	30	30	35
Lathyrus aphaca	-	-	10	10	-	-	10
Vicia hirsuta	-	10	-	-	10	-	10
Gnaphalium luteo-album	100	100	100	100	100	100	100
Anagallis arvensis	20	20	30	30	30	30	26
Antirrhinum majus	60	60	50	50	50	50	53
Leucas aspera	-	10	-	10	-	-	10
Chenopodium murale	-	-	10	10	-	10	10
Cannabis sativa	-	30	-	-	-	30	30
Cyperus rotundus	40	40	50	50	50	50	46
Cynodon dactylon	30	30	40	40	40	40	36

observed in sugarcane crop, only three species were dominant, *i.e. Gnaphalium luteo-album* (21.5/m^2), *Antirrhinum majus* (8.5/m^2) and *Trigonella foenum-graecum* (2.2/m^2). These three species entered in to real competition with the crop and with other less competent weeds. Other weeds showed very low density ranging between 0.1 to 1.9/m^2 and, thus, they were deemed as minor weeds which did not have much effect on the yield of the crop of the three fields surveyed.

Hussain (1983) reported that weed species with high percentage of density and frequency might exert competitive and allelopathic stress to reduce growth and yield of associated crop. The weed flora composition of these communities has definitely negative impact for lowering the yield and its yield components. Qureshi *et al.* (2001) found that the weeds of tomato crop with less importance values cannot be underestimated in their impact upon desired crop yield and its yield components due to their possible allelopathic effects.

It is generally considered that yield losses in sugarcane crop are either due to high population of weeds or environmental influences. Lemerle *et al.* (1996) concluded that the heavy weed pressure not only reduces crop yield significantly, but also has a detrimental effect on the following crops due to an unmanageable weed population.

The importance value index (IVI) of crop and weeds at different periods of growth are given in Table 4. It has been observed that weeds which had higher value for biomass and productivity also had higher IVI. The IVI of crop was higher than the individual weed species but total IVI of all the weeds exceeds the IVI of the crop. The IVI of the crop was 53.6 on 30th day, decreased on 45th day, increased on 60th and 75th day, again decreased on 90th day, and then again it gradually increased up to 92.01 on 105th day. Considerable fluctuations were observed in the IVI of weeds at different growth periods of the crop.

The Shanon index (Table 4) for diversity of crop and weeds at different periods of growth was 1.33 on 30th day, and increased upto 7.33 on 75th day, decrease on 90th day (1.81), and then again it increased slightly upto 3.33 on 105th day.

From this study it is clearly evident that sugarcane crop in this area is heavily infested with weeds that may cause huge loss to yield. The weed species dominantly inhabiting this area are common problems in almost all sugarcane growing areas of Western Uttar Pradesh.

It is suggested that this problem must be addressed by all the concerned quarters to eradicate/control these weeds by adapting appropriate measures including cultural, mechanical, biological and chemical methods that would give huge boost to the sugarcane yield and will enable the nation

Table 4 : Analytical characters of plant-weed association- importance value index and shanon index in sugarcane fields

	Importance value index					
Plant species	16 May	31 May	15 June	30 June	15 July	30 July
Saccharum officinarum (crop)	53.6	44.56	61.04	99.28	85.28	92.01
Fumaria indica	-	9.2	7.95	-	-	-
Coronopus didymus	-	9.75	6.74	13.01	14.02	19.63
Stellaria media	-	-	12.88	11.32	-	13.88
Trigonella foenum-graecum	20.13	11.9	10.91	13.12	13.81	12.81
Lathyrus aphaca	-	-	20.96	12.19	-	-
Vicia hirsute	-	10.95	-	-	15.46	-
Gnaphalium luteo-album	120.9	119.67	75.57	59.31	95.15	86.32
Anagallis arvensis	25.86	16.57	26.58	12.23	15.88	13.47
Antirrhinum majus	30.03	16.33	20.97	16.05	20.20	9.36
Leucas aspera	-	7.74	-	9.19	-	-
Chenopodium murale	-	-	9.63	13.60	-	8.47
Cannabis sativa	-	13.4	-	-	-	14.37
Cyperus rotundus	28.46	24.19	30.55	20.84	19.75	17.07
Cynodon dactylon	20.63	13.91	15.19	18.20	19.46	10.92
Total ivi of weeds	246.01	253.61	237.93	199.06	213.73	206.30
Shanon index	1.33	3.53	2.90	7.33	1.81	3.33

to ascertain the food security to the masses.

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