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Effect of Planting Pattern and Weed Management on Nutrient Uptake and Economics of Rabi Sunflower and its Associated Weeds

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ABSTRACT

The uptake of nutrients by sunflower crop and its associated weeds was studied under two planting patterns (45 x 30 cm and 60 x 22.5 cm) and six weed management practices (fluchloralin 1.0 kg/ha, pendimethalin 1.0 kg/ha, fluchloralin 0.5 kg/ha+pendimethalin 0.5 kg/ha, fluchloralin 0.5 kg/ha+pendimethalin 0.5 kg/ha supplemented with one HW at 40 DAS and HW twice at 20 and 40 DAS including unweeded check). Planting pattern of 45 x 30 cm significantly reduced the nutrient removal by weeds and consequently nutrient uptake by crop was increased. Among the weed management practices tried, the nutrient uptake by weeds was significantly lower with HW twice and it was at par with fluchloralin 0.5 kg/ha+pendimethalin 0.5 kg/ha supplemented with HW at 40 DAS. On an average, weeds under unweeded check removed 42.0 kg N, 15.5 kg P and 45.4 kg K/ha and monetary loss in terms of nutrient removal by weeds was maximum in unweeded check with an amount of Rs.1133/ha, besides reducing the seed yield by 62% than the best weed management practice, HW twice.

Key words : Planting pattern, weed management, nutrient uptake, yield, economics

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is the important oil seed crop of the India. Presently, it is cultivated in an area of 2.34 m ha with a production of about 1.14 mt and productivity of 615 kg/ha. The sunflower crop was accepted by the farming community due to its desirable characters like short duration, photo and thermo insensitivity, low seed rate and high seed multiplication rate alongwith best quality edible oil. The productivity has been often deflated due to heavy weed menace. Uncontrolled weed growth caused enormous loss of nutrients which in turn reduced the yield of sunflower crop upto an extent of 64% (Legha *et al.*, 1992). Heavy weed infestation in sunflower crop is mainly due to wider spacing, slower crop growth during early stages, highly responsive to fertilizers and irrigation. The increased growth of weeds offers severe competition for growth resources in general and for nutrients and water in particular. Planting pattern is one of the important agronomic management practices to reduce the weed growth by reduction in availability of solar radiation in closer planting pattern (Pradeep and Shanmugasundaram, 1996). To reduce the loss of nutrients due to weeds and increase the yield of irrigated **rabi** sunflower, planting pattern may be adjusted alongwith identifying economically and environmentally sound weed management practices. Therefore, the present investigation was carried out to know the effect of planting pattern and weed management practices on nutrient uptake, yield and economics of **rabi** sunflower under irrigated conditions.

MATERIALS AND METHODS

The experiment was conducted on sandy loam soils of wetland block of S. V. Agricultural College, Tirupati Campus of Acharya N. G. Ranga Agricultural University for two consecutive **rabi** seasons under irrigated conditions during 2002 and 2003. The soil of the experimental field was sandy loam in texture, low in available nitrogen (168 kg/ha), medium in available phosphorus (29.2 kg/ha) and available potassium (197 kg/ha) with the pH of 7.4. Twelve treatments comprising all combinations of two planting patterns (45 x 30 cm and 60 x 22.5 cm) with six weed management practices (unweeded check, fluchloralin at 1.0 kg/ha, pendimethalin at 1.0 kg/ha, fluchloralin at 0.5 kg/ha+pendimethalin at 0.5 kg/ha, fluchloralin at 0.5 kg/ha+pendimethalin at 0.5 kg/ha supplemented with one hand weeding at 40 DAS and HW twice at 20 and 40 DAS) were tested in a factorial randomized block design

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with three replications. The required quantity of herbicides was calculated as per the treatments then tank mixed and applied as aqueous spray by using spray fluid at 600 l/ha with knapsack sprayer fitted with flat fan nozzle. Fluchloralin was applied one day before sowing as per the treatments and incorporated in the soil, while pendimethalin was applied as pre-emergence immediately after sowing of the crop. The recommended dose of fertilizers was 80 kg N, 50 kg P_2O_5 and 30 kg K_2O/ha. Entire dose of phosphorus and potassium and half the dose of nitrogen was applied as basal and remaining half of the dose of nitrogen was applied at 30 DAS. The oven-dried samples of weed and crop at harvest were analysed for nutrient content. Nitrogen was estimated by Microkjeldhal method, phosphorus was estimated by Vanado molybdo phosphoric method in nitric acid system and potassium was estimated with the help of flame photometry (Jackson, 1967). The nutrient uptake by crop and its associated weeds were determined by multiplying the per cent nitrogen, phosphorus and potassium content in the plants with their respective dry weights at harvest.

RESULTS AND DISCUSSION

The predominant weeds present in the experimental field were *Digitaria sanguinalis, Dactyloctenium aegyptium* in grasses, the only sedge *Cyperus rotundus* and *Cleome viscosa, Euphorbia hirta* and *Borreria hispida* in broad-leaved weeds, during both the years of study.

Nutrient Uptake by Weeds

Significant variation in planting pattern and weed management practices were recorded with respect to nutrient uptake by **rabi** sunflower and its associated weeds (Table 1). Closer planting pattern of 45 x 30 cm recorded significantly lower nutrient uptake by weeds than the wider planting pattern of 60 x 22.5 cm during both the years. On an average, weeds removed 14.6 and 18.2 kg nitrogen, 5.2 and 6.7 kg phosphorus, and 16.4 and 22.3 kg potassium/ha with a planting pattern of 45 x 30 cm and 60 x 22.5 cm, respectively. The nutrient uptake by weeds in closer planting pattern is lesser mainly due to lower weed dry weight accumulation, which results in competition offered by weeds for nutrients was significantly reduced and these nutrients were available to crop plants at the higher proportion. The highest nutrient uptake by weeds was recorded with unweeded check followed by fluchloralin 0.5 kg/ha+pendimethalin 0.5 kg/ha, mainly because of higher dry matter accumulation of weeds. Uptake of nutrients in HW twice was statistically at par with fluchloralin 0.5 kg/ha+pendimethalin 0.5 kg/ha supplemented with one HW and both of them significantly recorded lesser nutrient uptake by weeds than rest of the weed management practices. The mean of two years' data indicated that heavy weed infestation in unweeded check removed 42.0 kg nitrogen, 15.5 kg phosphorus and 45.4 kg potassium/ha, whereas in HW twice the weeds removed only 5.7 kg nitrogen, 1.8 kg phosphorus and 6.9 kg potassium/ha. Similar findings were also reported by Kumara *et al.* (2007). The highest nutrient uptake by weeds was recorded with unweeded check followed by fluchloralin 0.5 kg/ha+pendimethalin 0.5 kg/ha mainly because of higher dry matter accumulation. Application of fluchloralin at 0.5 kg+pendimethalin at 0.5 kg/ha recorded higher nutrient uptake by weeds next to the unweeded check due to its sub-lethal dose and lack of synergistic effect between fluchloralin and pendimethalin in combination at 0.5 kg/ha each. These results are corroborative with the findings of Dalavai *et al.* (2008).

Nutrient Uptake by Crop

Phosphorus and potassium uptake by the crop was statistically similar in different planting patterns during both the years of study. However, nitrogen uptake by the crop was significantly higher in closer planting pattern of 45 x 30 cm than 60 x 22.5 cm due to lesser weed dry matter accumulation and higher crop dry matter in former planting pattern. Among the weed management practices tried, nitrogen uptake by crop was significantly higher with HW twice followed by pendimethalin 1.0 kg and fluchloralin 1.0 kg/ha. The uptake of phosphorus and potassium was comparable with each other in HW twice, pendimethalin 1.0 kg/ha and fluchloralin 1.0 kg/ha. The mean uptake of nitrogen, phosphorus and potassium by crop in unweeded check was 23.2, 6.4 and 32.5 kg/ha, whereas in HW twice it was 52.5, 19.6 and 59.5 kg/ha, respectively. This indicates that where the removal of nutrients by crop was higher, the corresponding uptake of nutrients by weeds was lesser and vice-versa (Madhu *et al.,* 2006).

Table 1. Nutrient uptake (kg/ha) by sunflower and its associated weeds under different planting patterns and weed management practices at harvest

Treatments	Weed						Sunflower					
	Nitrogen		Phosphorus		Potassium		Nitrogen		Phosphorus		Potassium	
	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003
Planting patterns												
45 x 30 cm	15.6	13.7	5.3	5.1	16.5	16.2	44.6	43.4	15.3	15.3	52.9	48.2
60 x 22.5 cm	19.1	17.2	6.8	6.6	21.9	22.6	41.9	42.0	14.2	14.6	51.1	45.3
LSD (P=0.05)	2.1	2.0	1.3	1.0	4.1	4.2	1.3	0.8	NS	NS	NS	NS
Weed management												
Unweeded check	43.2	40.8	15.3	15.2	44.6	46.1	22.4	24.1	6.2	6.6	36.5	28.2
Fluchloralin 1.0 kg/ha	15.8	14.3	5.7	6.0	18.9	18.7	48.4	48.3	16.8	17.2	50.5	52.1
Pendimethalin 1.0 kg/ha	14.4	13.1	5.6	4.9	18.5	17.3	49.7	49.5	17.7	17.5	59.5	54.8
Fluchloralin 0.5 kg+Pendimethalin 0.5 kg/ha	16.3	15.2	6.3	6.5	19.6	20.5	39.7	37.6	12.5	14.1	44.3	41.2
Fluchloralin 0.5 kg+Pendimethalin 0.5 kg/ha+HW	6.9	4.9	1.9	1.9	7.4	7.2	46.4	45.6	14.8	15.7	52.9	48.0
HW twice	6.5	4.8	1.8	1.8	7.2	6.5	53.0	52.2	20.5	18.8	61.4	57.6
LSD (P=0.05)	4.4	4.2	2.8	2.6	8.3	8.5	2.4	1.5	4.4	1.8	6.2	6.8

NS–Not Significant.

Yield

Planting pattern and weed management practices significantly influenced the dry matter production, seed and stalk yield and economics of **rabi** sunflower during both the years of study (Table 2). Significantly the highest seed and stalk yield including harvest index were recorded with closer planting pattern of 45 x 30 cm than planting pattern of 60 x 22.5 cm. The former planting pattern recorded 8.5% higher seed yield over 60 x 22.5 cm. These results are corroborative with those of Avit Sen *et al.* (2002). This was mainly due to increased nutrient uptake by the crop resulting from lesser weed competition and maintaining optimum plant population in 45 x 30 cm spacing. Hand weeding twice, pendimethalin 1.0 kg/ha and fluchloralin at 1.0 kg/ha were statistically at par with each other and these treatments obtained significantly higher seed and stalk yield including harvest index than rest of the weed management practices during both the years of study. The similar trend was also observed in crop dry matter production. Seed yield of sunflower was positively correlated with nitrogen uptake by crop (r=0.841) and negatively correlated with nitrogen uptake by weeds (r=-0.418). Basavarajappa *et al.* (1996) also reported enhancement of nitrogen uptake by sunflower in hand weeded plots due to maintenance of weed free period during crop growth period. The better performance of crop in HW twice and herbicide treated plots was mainly due to increased nutrient uptake and very low dry matter accumulation of weeds. All the above said parameters were the lowest with the unweeded check due to heavy weed infestation and it was closely followed by fluchloralin 0.5 kg/ha+pendimethalin 0.5 kg/ha. This might be due to lack of complimentary effect of these two herbicides at 50% reduced dose to suppress the weed growth during critical period of crop-weed competition. On an average, heavy weed infestation in unweeded check reduced the seed yield by 62% over the best weed management practice HW twice.

Economics

Closer planting pattern of 45 x 30 cm obtained the highest B : C ratio than 60 x 22.5 cm due to higher seed yield and lesser cost of weeding. The highest B : C ratio was registered with pendimethalin at 1.0 kg/ha and it was at par with fluchloralin at 1.0 kg/ha (Table 2). Hand weeding twice recorded significantly lesser B : C ratio than the above two weed management practices due to increased cost of manual weeding even though it recorded comparable seed yield. However, monetary loss or gain due to different planting patterns and weed management practices was altered due to nutrient removal by weeds. Monetary loss in terms of nutrients removed by weeds was altered just by manipulating the non-monetary input i. e. adjusting the planting pattern without changing the plant population per unit area. On an average, closer planting pattern of 45 x 30 cm recorded lesser monetary loss due to nutrient uptake by weeds

Table 2. Effect of planting patterns and weed management practices on yield, harvest index and B : C ratio of **rabi** sunflower

Treatments	Crop dry matter accumulation (t/ha)		Seed yield (kg/ha)		Stalk yield (kg/ha)		Harvest index (%)		B : C ratio	
	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003
Planting patterns										
45 x 30 cm	5.37	5.22	1603	1554	3585	3464	29.66	29.78	2.07	1.97
60 x 22.5 cm	5.18	5.06	1451	1458	3421	3296	27.50	28.15	1.86	1.83
LSD (P=0.05)	0.07	0.05	83.0	61.0	85.0	58.0	1.41	1.08	0.06	0.06
Weed management										
Unweeded check	2.87	2.69	732	692	1946	1820	23.25	25.47	1.09	1.01
Fluchloralin 1.0 kg/ha	5.78	5.68	1804	1699	3906	3809	30.93	30.40	2.39	2.22
Pendimethalin 1.0 kg/ha	5.89	5.77	1861	1743	4068	3941	31.03	30.49	2.42	2.24
Fluchloralin 0.5 kg+Pendimethalin 0.5 kg/ha	5.40	5.29	1316	1375	33.84	3253	26.18	27.83	1.75	1.81
Fluchloralin 0.5 kg+Pendimethalin 0.5 kg/ha+HW	5.63	5.52	1537	1502	3606	3429	28.30	28.09	1.85	1.92
HW twice	6.03	5.89	1914	1824	4137	4044	31.80	30.93	2.16	2.02
LSD (P=0.05)	0.15	0.13	194	125	188	132	3.09	2.82	0.12	0.12

Table 3. Effect of planting patterns and weed management practices on economics of nutrient removal by weeds

Treatments	2002							2003						
	Cost of cultivation (Rs./ha)	Cost of weeding (Rs./ha)	Monetary loss in terms of nutrients removal by weeds (Rs./ha)					Cost of cultivation (Rs./ha)	Cost of weeding (Rs./ha)	Monetary loss in terms of nutrients removal by weeds (Rs./ha)				
			N	P	K	Total	Gain/ Loss			N	P	K	Total	Gain/ Loss
	1	2	3	4	5	6	(2-6)	1	2	3	4	5	6	(2-6)
Planting patterns														
45 x 30 cm	10924	-	162	113	135	410	-410	11187	-	142	108	133	383	-383
60 x 22.5 cm	11080	-	199	145	180	524	-524	11203	-	179	179	140	504	-504
Weed management														
Unweeded check	9616	-	449	325	366	1140	-1140	9820	-	424	323	378	1125	-1125
Fluchloralin 1.0 kg/ha	10616	1000	164	121	155	440	560	10820	1000	149	128	153	430	570
Pendimethalin 1.0 kg/ha	10816	1200	150	119	152	421	779	11020	1200	136	104	142	382	818
Fluchloralin 0.5 kg+ Pendimethalin 0.5 kg/ha	10716	1100	170	134	161	465	635	10920	1100	158	138	168	464	636
Fluchloralin 0.5 kg+ Pendimethalin 0.5 kg/ha+HW	11788	2172	72	40	61	173	1999	11760	1940	51	40	59	150	1790
HW twice	12461	2845	68	38	59	165	2680	12770	2950	50	38	53	141	2809

N–Nitrogen @ Rs. 10.4/kg, P–Phosphorus @ Rs. 21.25/kg, K–Potassium @ Rs. 8.20/kg.

with an amount of Rs. 118/ha than wider planting pattern, besides having the yield advantage due to lesser weed dry matter accumulation (Table 3). Among the weed management practices tried, hand weeding twice was effective in decreasing the nutrient removal by weeds due to lesser weed dry matter accumulation by weeds at early and later stages of crop growth than rest of the weed management practices. On an average, monetary advantage due to weeding with respect to nutrient uptake by weeds was the maximum in HW twice followed by fluchloralin 0.5 kg/ha+pendimethalin 0.5 kg/ha supplemented with HW with an amount of Rs. 2745 and 1895/ha, respectively. Monetary loss in terms of nutrient removal by weeds was maximum in unweeded check with an amount of Rs. 1133/ha, besides reducing the seed yield by 62% than best weed management practice, HW twice.

The present study concluded that planting of sunflower at 45 x 30 cm alongwith pre-emergence application of pendimethalin at 1.0 kg/ha was very effective in reducing the nutrient removal by weeds, which results in increased seed yield and it was remunerative to farmers due to less cost of weeding. It also concluded that investment on weed management practices not only helps in increasing monetary advantage, but also curtailing the nutrient drained by weeds.

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