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Influence of Weed Management Practices on Economics and Nutrient Uptake in Sunflower (*Helianthus annuus* L.)

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ABSTRACT

A field experiment was undertaken during spring-2014 at the Research Farm of Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar to study the effect of integrated weed management practices on weed and crop performances. The experiment was laid out in a randomized block design, consisting ten treatments. The soil of experimental site was sandy loam in texture with alkaline pH (8.2), medium in organic carbon content (4.5 g/kg) and available N, P and K. The results reveal that the weed free treatment (T_9) lowered the weed population (by 118.30%), weed dry biomass (109.40%) and weed control efficiency (78.06%) compared to unweeded control which will reflected to significant increment in seed and stalk yield (98.00% and 54.80%) as well as economics of crop. Due to the highest yield in treatment T_9, it was also recorded the highest uptake of N, P and K nutrients i.e., 53.37, 22.24 and 61.17 kg/ha, respectively. In contrast the nutrient uptake by weeds was recorded the lowest in this treatment (T_9) due to lower weed biomass. So, efficient ecological acceptable integrated weed management practices are essential to achieve a maximum while reducing the weed population.

Key words: *Sunflower, Weed growth, Yield, Economics, Nutrient uptake*

INTRODUCTION

Sunflower *(Helianthus annuus* L.) has emerged as one of the important oil seed crops in India because of its photo-insensitivity, short duration, low water requirement and good quality oil. There are several constraints in sunflower production. Weed infestation is one of the major factors for loss in yield under assured rainfall conditions. Approximately 83.0% of yield loss was recorded due to weed infestation[5]. It has now been well established that losses from weeds are far more than due to insects' pest and diseases. Sunflower is a poor competitor with weeds on an account of its slow growth in the initial stage. The early growth period is the most critical stage at which stress of any kind can affect the economic yields. Weed competition is one of such important stress during this period.

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Weeds not only compete with crop plants for nutrients, soil moisture space and sunlight but also serve as an alternate host for several insect pests and diseases. Therefore, timely weed control is essential for optimizing the yields and availability of nutrient under sunflower cultivation. The age-old practice of controlling weeds in sunflower by hand weeding and hoeing is time consuming, expensive and tedious though much effective. However, timely weed control may not be possible manually due to non availability of labors and high rate of wages during peak period of farm operations. Hence, chemical weed control appears to hold a great promise in dealing with effective, timely and economic weed suppression. Keeping all these in view, the present study was carried out to evaluate the various herbicides for their weed control efficiency and their influence on productivity and profitability of sunflower.

MATERIAL AND METHODS

The field experiment was started during *spring*-2014 at Tirhut college of Agriculture farm, Dholi, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar (Formerly Rajendra Agricultural University, Pusa, Samastipur, Bihar). The experiment site was situated at 25^0 59' N latitude and 85^0 35' E longitudes with an altitude of 58.0 m above the mean sea level under humid sub tropical climatic zone which is greatly influenced by monsoon. The average annual rainfall is about 1163 mm, out of which nearly 1026 mm is received during the monsoon extending from the middle of June to middle of October. The period between third weeks of December to first half of January receives occasional winter showers. January is the coldest month of the year with an average maximum and minimum temperature of 23.2 and 7.9 ^{0}C, respectively. The soil was sandy loam in texture with alkaline pH (8.2), medium in organic carbon content (4.5 g/kg) and available N, P and K. The experiment was laid out in Randomized Block Design (RBD), replicated thrice within a plot and involved 10 treatments (Table 1). The crop was fertilized at the rate of 150 kg N, 60 kg P_2O_5 and 40 kg K_2O/ha in all the treatments. Nitrogen was applied through urea in three equal splits (sowing time, active tillering stage and panicle initiation stage); P_2O_5 and K_2O were applied as single basal dose in the form of diammonium phosphate (DAP) and muriate of potash (MOP) along with one third dose of nitrogen at the time of crop sowing. The seeds of KBSH-44 cultivar of sunflower were sown by hand dibbed method with spacing of 60 cm × 30 cm on 18th Dec. 2013. Weed growth attributes viz., weed population and weed dry biomass were recorded with the help of a quadrant 0.50 m × 0.50 m placed randomly at two places in each plot at 30 days after sowing (DAS), 60 DAS and at harvest. Individual species wise weed counts were grouped into grasses, sedges and broad-leaved weeds and expressed as number/m^2. For the estimation of weed dry biomass the weed samples were cut at ground level, washed with the help of tap water; sun dried and further dried at 70 ^{0}C in oven till attained constant weight. Thereafter, the dry weight of weeds was recorded in g/m^2. Weed control efficiency (%) was calculated by using formula: W.C.E (%) = (Wc-Wt/Wc) ×100, where, Wc = Dry matter of weeds in weedy check (control). Wt = Dry matter of weeds in weed control treatments. Seed and stalk yield were determined from the net plot area and was weighed in kg and converted into kg/ha.

The nutrient uptake by the crop was calculated by multiplying the nutrient content with dry matter yield. The nutrient content in grain and straw were determined as per the standard procedure[7]. Economics of different treatments was calculated by taking into account the prevailing market price of inputs and produce. Gross returns were worked out for each treatment based on quality and market prices of the produce. The net returns were worked out by deducting the cost incurred from the gross returns of the particular treatment. Benefit cost (B: C) ratio was incurred by dividing the net return with cost of cultivation. Statistical analysis was performed using the SPSS statistical package.

RESULTS AND DISCUSSION

Weed growth attributes

Weed growth attributes *viz.*, weed population, weed dry biomass and weed control efficiency were significantly (P=0.05) influenced with the application of different weed management practices (Table 2). The treatment comprising T_9: weed free (hand weeding at 20 and 40 days after sowing) lowered the weed population (by 118.30%), weed dry biomass (109.40%) and weed control efficiency (78.06%) which was produced statistically similar effect to T_2: Pendimethalin @0.75 kg a.i./ha (38.7 CS new molecule) as PE + one intercultural (IC) at 20 DAS *fb* hand weeding (HW) at 40 DAS. It may be due to complete removal of weeds by hand at appropriate time. Treatment T_2 closely followed treatment T_9 reason that the reduced germination and emergence of weeds due to pre-emergence application of pendimethalin followed by one interculture at 20 DAS and hand weeding at 40 DAS. These results are in agreement with those of Kironmay *et al*.[2], and Pannacci *et al*[3].

Seed and stalk yield

Better weed control efficiency observed under treatment T_9 which was well reflected to significant (P=0.05) effect on seed yield as well as stalk yield (Table 2). The highest seed and stalk yield were obtained in lowest weed population treatment i.e., treatment T_9 which was statistically similar to treatment T_2. The increment in seed and stalk yield was recorded under T_9 (98.00% & 54.80%) and T_2 (94.50% & 53.40%) over control. This could be due to weed free environment, especially at critical period of crop-weed competition growth, which might have resulted in increased production and translocation of photosynthates sufficient to supply the sink needs[1]. The unweeded control treatment was not effective in promoting yield of crop due to poor weed control efficiency and highest population and biomass of weed.

Economics

Economic analysis of crop production shows that significant effect (P=0.05) of integrated weed management practices on net return and benefit cost ratio (Table 2). Among the different weed management practices the treatment T_4 (Pendimethalin @1.0 kg a.i./ha (38.7 CS new molecule) as pre-emergence + propaquizafop @ 62 g a.i./ha at 20 DAS as post emergence) achieved the highest net return (Rs. 35503.00/ ha) over control which was closely followed by T_9. This might be due to lesser cost of pre- and post-emergence herbicides application and increased seed yield in these weed management practices than the unweeded control (T_{10}). The corresponding increment in benefit cost ratio recorded in treatment T_4 was 2.47 times higher over unweeded control (T_{10}) due higher seed yield and net return.

Nutrient uptake by crop and weed

Nutrient uptake by crop and weed was significantly (P=0.05) influenced with the implementation of integrated weed management practices (Figure 1). The highest uptake of N, P and K i.e., 53.37, 22.24 and 61.17 kg/ha, respectively by sunflower crop was recorded with hand weeding at 20 and 40 days after sowing (T_9) which was increased over control by 107.7, 101.6 and 98.3%, respectively. Whereas, the lowest uptake of N, P and K was recorded with unweeded control (T_{10}) treatment, due to lowest crop dry matter production. In contrast the lowest uptake of N, P and K was recorded with treatment T_9 i.e., 2.50, 1.17 and 2.03 kg/ha, respectively due to lowest weed infestation and weed dry biomass. The higher weed incidence treatments i.e., treatment T_8 and T_{10} had the ability to harvest higher uptake of N (10.34-10.46 kg/ha), P (5.02-5.09 kg/ha) and K (8.73-8.82 kg/ha) nutrients as compared to other treatments. These results are in conformity with those of Sumathi *et al.*[6] and Sankar and Subramanyam[4].

Table 1: Different weed management protocols under sunflower cultivation

	Weed management practices
T_1:	Pendimethalin @0.75 kg active ingredient (a.i)./ha [38.7 capsulated suspension (CS) new molecule] as pre-emergence (PE)
T_2:	Pendimethalin @0.75 kg a.i./ha (38.7 CS new molecule) as PE + one intercultural (IC) at 20 DAS *fb* hand weeding (HW) at 40 DAS
T_3:	Pendimethalin @1.0 kg a.i./ha (38.7 CS new molecule) as PE + quizalofop ethyl @ 37.5 g a.i./ha at 20 DAS
T_4:	Pendimethalin @1.0 kg a.i./ha (38.7 CS new molecule) as PE + propaquizafop @ 62 g a.i./ha at 20 DAS
T_5:	Pendimethalin @1.0 kg a.i./ha (38.7 CS new molecule) as PE + fenoxoprop ethyl @ 37.5 g a.i./ha at 20 DAS
T_6:	One H.W at 30 DAS
T_7:	Pendimethalin @1.0 kg a.i./ha (38.7 CS new molecule) as PE + one weeding by power weeder at 35 DAS
T_8:	One weeding by power weeder at 35 DAS
T_9:	Weed free (H.W at 20 and 40 DAS)
T_{10}:	Unweeded control

Table 2: Effect of weed management practices on weed growth, and seed yield & economics of sunflower crop

Treatments*	Weed population (/m^2)	Weed dry biomass (g/m^2)	Weed control efficiency (%)	Seed yield (kg/ha)	Stalk yield (kg/ha)	Net returns (Rs./ha)	B: C ratio
T_1	16.27 (264.13)**	8.14 (65.24)	20.96	16.73	44.33	40,544.31	1.51
T_2	8.67 (74.25)	4.68 (20.92)	74.67	21.49	49.27	49,519.64	1.39
T_3	11.86 (139.64)	5.86 (33.41)	59.48	18.90	47.07	46,583.98	1.61
T_4	11.43 (129.69)	5.65 (30.94)	62.35	21.16	48.97	55,233.31	1.93
T_5	12.70 (160.26)	6.30 (38.65)	53.10	18.15	46.73	44,350.31	1.55
T_6	15.00 (223.94)	7.69 (58.09)	29.51	16.51	42.37	36,289.64	1.21
T_7	14.62 (213.16)	7.71 (58.55)	29.12	17.55	46.03	42,506.64	1.51
T_8	16.97 (286.88)	9.07 (81.21)	1.18	14.62	38.96	32,384.98	1.22
T_9	8.31 (68.58)	4.36 (18.11)	78.06	21.88	49.71	50,135.98	1.38
T_{10}	18.15 (328.59)	9.13 (82.49)	0.00	11.05	32.12	19,730.31	0.78
SEm±	0.23	0.12	-	0.85	2.15	3,111.39	0.10
CD (P = 0.05)	0.69	0.35	-	2.56	6.44	9,316.04	0.30

* See table 1 for treatment details; ** Figures in parentheses are original values which were subjected to square root transformation.

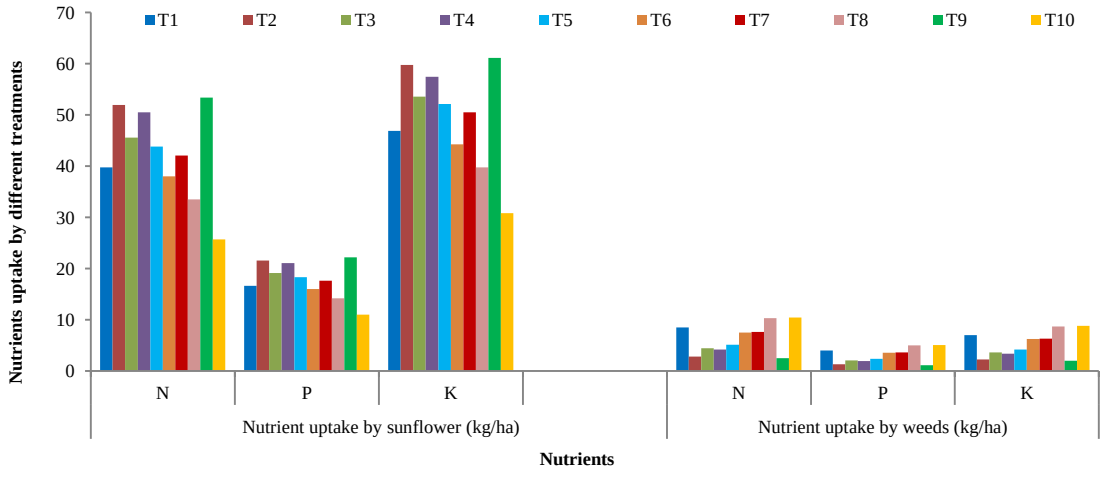

Fig. 1: Effect of weed management practices on uptake of nutrients by sunflower crop and weed

CONCLUSION

On the basis of foregoing finding it can be concluded that treatment consisted weed free (T_9) and pre emergence application of Pendimethalin (T_2 &T_4) achieved the higher yield due to better weed control efficiency which will reflected to more economic profitable option for sunflower crop.

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