

Efficient and Economic use of Limited Resources for Maximizing Productivity and Profitability of Sunflower (*Helianthus Annuus L.*)

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How to cite this article:

Mahendra Singh Pal, Avinash Kumar, Abhishek Bahuguna. Efficient and Economic use of Limited Resources for Maximizing Productivity and Profitability of Sunflower (*Helianthus Annuus L.*). Indian J Plant Soil. 2019;6(1):33-36.

Abstract

Field experiment was carried out during spring season of 2013 at the N.E. Borlaug Crop Research Centre, G.B. Pant University of Agriculture and Technology, Pantnagar (Uttarakhand) to study the effect of production factors for efficient and economic use of limited resources for optimizing sunflower (*Helianthus annuus L.*) production. The soil of experimental site was sandy loam in texture having pH 6.98, organic carbon 0.72%, available N 230 kg/ha, P 18.8 kg/ha and K 255.8 kg/ha. Among the absence of single production factor, plant protection was found the most crucial production factor for sunflower production with reduction of 32.9% in seed yield followed by weeding with 23.2% in spring season in Tarai zone of India while other factors like fertilizer and thinning were equally important as these factors may reduce 20-23% sunflower seed yield alone. Similarly in absence of two production factors, fertilizer + plant protection had the highest seed yield reduction followed by plant protection + thinning. Therefore the plant protection and fertilizer management need special care for boosting sunflower production in spring season in India.

Keywords

Production factors; Sunflower; Plant Protection; Thinning; Weeding.

Introduction

Sunflower (*Helianthus annuus L.*) is one of the important oilseed crops of India and world with

acreage of 344.2 thousand ha, production 240.7 thousand tons with productivity 699 kg/ha in India (2016-17), while world produces 51.46 million tons in 2018-19 with leading countries Ukraine 15 mT, Russia 12.71 MT, European Union 9.9 MT, Argentina 3.5 MT, Turkey 1.8 MT and Others 855 MT (Statista, 2019). Basically Sunflower is a subtropical and temperate crop but it is widely adaptable and drought tolerant crop grown all parts of India in different crop seasons but in North India it is grown in spring season from Month February to June under irrigated conditions. Besides, quality of sunflower oil is very high mainly because it contains 85-90% unsaturated fatty acids including oleic and linoleic acids.

The low average productivity of sunflower is attributed due poor management of available resources like fertilizer, water, weeding, thinning and plant protection because these resources can be efficiently exploited agronomically for high resource use efficiencies. It is always debated which resource is most important despite different research findings have already been made. The significance

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Received on 19.05.2019; Accepted on 28.06.2019

of production resources and its contribution to yield is variable with soil, climatic and crop management. Therefore the present study was carried out in Tarai region of Uttarakhand during spring season to find out the important production resources of sunflower for efficient and economic use for boosting sunflower production in the region.

Materials and Methods

Field experiment was carried out during spring season of 2013 at the N. E. Borlaug Crop Research Centre G.B. Pant University of Agriculture and Technology, Pantnagar (Uttarakhand) to study the effect of production factors for efficient and economic use of limited resources for optimizing sunflower (*Helianthus annuus L.*) production. The soil of experimental site was sandy loam in texture having pH 6.98, organic carbon 0.72%, available nitrogen 230 kg/ha, P 18.8 kg/ha and K 255.8 kg/ha. The experiment consisted of nine treatments i.e. T₁: Full package (Control), T₂: T₁ - Fertilizer (f), T₃: T₁- Plant protection (pp), T₄:T₁ - Thinning (T), T₅:T₁ - Weeding (w), T₆:T₁ - (f + pp), T₇:T₁ - (pp + T), T₈:T₁ - (f+T) and T₉:T₁ - (f+T+ w) was planted under randomized Block Design with three replications. In general, the crop was grown under recommended agronomic practices. The fertilizer dose 120:60:40 of N:P₂O₅:K₂O kg/ha. 50% N was applied as a basal and remain 50% was top dressed at bud initiation stage. The full P and K were applied as basal. The crop was irrigated at all physiological stages. The uniform mixture spray of Clorpyrifos and Monocrotophos (1:1) @ 0.2% was made twice in all experiments at knee high and 15 days after silking stage. The randomly selected samples of five plants were taken from every plot at harvest for analysis of growth and yield parameters and also economics.

Results and Discussion

a. Growth attributes

All the growth and yield parameters, seed yield and harvesting index were significantly affected by different production factors (Table 1). Sunflower grown under full package of practices produced significantly taller plants that were statistically at par when fertilizer was not applied. The plant height was reduced significantly under absence of either single or in combination of different production factors. The lowest plant height was observed under treatment where fertilizer was not applied in combination with non-adoption of plant protection measures. The 50% heading also affected significantly with lowest value under full package of practices. The plant dry matter accumulation was also recorded significantly higher under full package of practices that was significantly similar to treatments where thinning was not adopted as well as the fertilizer and plant protection measures were not followed. In general, plant dry matter accumulation reduced in absence of any production factor compared to full package practices. The plant population was also influenced significantly by production inputs and the highest plant population was counted under treatments where thinning was not made and the lowest values in unfertilized treatments indicating fertilizer alone can play major role in sustaining and maintaining plant population. It is also evident from results that the plant stand was further reduced in absence of more than one resource inputs.

b. Yield attributes

The sunflower head size was significantly affected by different treatments and highest value was recorded under full package of practices

Table 1: Effect of different production factors on growth, yield attributes, seed yield and harvest index of sunflower at Pantnagar during spring 2013

Treatments	Plant height (cm)	50% Heading (days)	Plant population (000 plants /ha)	Head Size (cm)	Seed wt/pl (g)	Dry wt/pl. (g)	100 seeds wt. (g)	Seed yields Kg/ha	Reduction % over control	Harvest Index (%)
T: Full package (Control)	146	68	51.7	17.0	41.7	130.3	4.83	2213	-	33.3
T ₂ : T ₁ - Fertilizer (F)	145	71	51.2	16.4	32.7	99.7	3.77	1721	22.2	32.3
T ₃ : T ₁ - Plant protection (PP)	137	72	52.9	16.7	31.3	105.0	4.17	1484	32.9	30.0
T ₄ : T ₁ - Thinning (T)	137	69	54.9	15.4	30.0	125.3	4.23	1724	22.0	24.0
T ₅ : T ₁ - Weeding (W)	139	71	48.9	16.8	34.3	117.0	3.70	1691	23.6	29.3
T ₆ : T ₁ - (F + PP)	135	70	46.4	16.0	29.3	127.3	4.03	1345	39.2	23.3
T ₇ : T ₁ - (PP + T)	139	71	48.1	16.6	23.3	100.7	3.93	1390	37.2	23.0
T ₈ : T ₁ - (F + T)	138	70	48.3	15.4	29.3	106.0	3.73	1478	33.2	27.7
T ₉ : T ₁ - (F + T + W)	136	72	43.2	14.4	24.0	107.3	3.87	1385	37.4	27.0
SEm±	02	01	0.5	0.4	1.3	5.7	0.22	105	-	1.3
CD (0.05)	07	02	1.4	1.2	3.9	17.1	0.66	314	-	3.9
CV%	3.1	1.4	-	4.3	7.4	8.7	9.4	11.3	-	8.1

followed by treatments where weeding and plant protection were not adopted but both treatments had statistically equal values. The smallest head size was measured in treatments where thinning was not completed, so thinning was found most significant singly factor that reduced head size. The sunflower head size was reduced further by inattention of more than one factors like fertilizer coupled with thinning, fertilizer + plant protection. The smallest head size was observed where fertilizer + thinning + weeding were not adopted. It indicated that fertilizer was the second most important single factor that governed the head size.

Similarly, Sunflower grown under full package of practices produced significantly highest seed weight/plant, while the lowest value was found where both thinning and plant protection were not taken care of during crop production. The reduced seed yield per plant was attributed to lower head size and more infestation of pest and diseases that reduced the per plant seed yield. The 100 seed weight was recorded significantly higher at T₁ that remained significantly equal to T₃ and T₄ treatments. The lowest value was recorded at T₅, where weeding was not done and followed by unfertilized treatment.

c. Seed Yield

The seed yield was recorded significantly highest under full package whereas the seed yield was reduced drastically in all other treatments where either one or in combination of different production factors were not adopted (Table 1). The highest reduction *i.e.*, 39.2% was recorded in treatment where the combined fertilizer and plant protection were not adopted, followed by T₉, 37.4% where combined fertilizer, thinning & weeding were not adopted. n

Nawaz *et al.* (2003) found 112% increase in yield at 120:90:60 of N:P:K over unfertilized sunflower. Nasim *et al.* (2017) reported that the productivity of hybrids increased with the increasing doses of N fertilizer. Narendra *et al.* (2017) reported that weed free plot had 194% higher seed yield than weedy check. The reduction in sunflower yield was in range of 22.02% - 39.2% in absence of different production factors. Meti *et al.* (2016) reported that 75.8% sunflower seed yield was increased by weed control with pendimethalin at 1 kg a.i. per ha. As PE + Quizalofop at 37-5g a.i. per ha at 17 DAS compared to weedy check. The harvest index was also recorded significantly higher under full package of practices and the lowest under absence of both fertilizer and plant protection. In general, plant protection was found most crucial production factor in sunflower production and its absence, the sunflower yield was reduced to the tune of nearly 33% compared to full package of practices. The production factors like fertilizer, thinning and weed control had almost equal effect on sunflower seed yield with nearly 22-24% yield reduction. Bindu *et al.* (2017) reported that adoption of alone thinning gave 10.8% and 12.1% higher sunflower yield and net profit, respectively than without thinning in mechanically planted in Punjab. The combine effect of fertilizer and plant protection measures had the highest adverse effect on sunflower yield with nearly 40% reduction in seed yield. Ion *et al.* (2015) found higher seed yield at increasing plant stand from 50k-75k but the plant yield decreased. Higher plant stand had positive impact on growth and seed yield under favorable conditions. The harvest index was recorded significantly lower under treatments where thinning was not completed. Similarly the treatment where thinning coupled with plant protection were not adopted gave the lowest harvest index due to poor seed yield per plant.

Table 2: Effect of different production factors on economics and B:C ratio at Pantnagar during spring 2013

Treatments	Cost of cultivation (Rs./ha)	Gross Return (Rs./ha)	Net returns (Rs./ha)	B:C ratio
T: Full package (Control)	17500	81880	64380	4.68
T ₂ : T ₁ - Fertilizer (F)	13500	63671	50174	4.72
T ₃ : T ₁ - Plant protection (PP)	15100	54917	39817	3.64
T ₄ : T ₁ - Thinning (T)	16500	63791	47291	3.87
T ₅ : T ₁ - Weeding (W)	16000	62566	46566	3.91
T ₆ : T ₁ - (F + PP)	11100	49779	38679	4.48
T ₇ : T ₁ - (PP + T)	14100	51432	37332	3.65
T ₈ : T ₁ - (F + T)	12500	54704	42204	4.38
T ₉ : T ₁ - (F + T + W)	11000	51235	40235	4.66
SEm±	-	3880	3880	0.26
C D (0.05)	-	11631	11631	0.79

* Sunflower sale rate- Rs 3700/- per quintal (Minimum support price).

d. Economics

The gross returns, net returns and B: C ratio were affected significantly by different production resources (Table 2). Significantly highest gross and net returns were recorded under full package of practices followed by T₄ and T₅ treatments where thinning and weed control measures were not adopted mainly because of higher plant stand and seed yield. Similarly, the B:C ratio was recorded significantly higher at T₂ followed by T₁, T₇, T₈ and T₆ treatments. The lower cost of cultivation due to absence of different production factors like fertilizer, plant protection measures *etc.* greatly contributed to B:C ratio.

Conclusion

The experimental results indicated that plant protection was the most crucial production factor followed by fertilizer for sunflower production in spring season in Tarai zone of India. The other factors like thinning and weeding were equally important as these factors reduced 20-23% sunflower seed yield alone.

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