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Development of best management practices for maximum economic yield of sunflower (*Helianthus annuus* L.)

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Abstract
A field experiment was carried out during *spring*, 2013-2016 at T.C.A, Dholi, Muzaffarpur (Bihar) to study the development of best management practices for maximum economic yield of sunflower. The experiment was laid out in Split plot design with 3 replications. The treatment comprised 2 (main) x 3 x 3 (Sub) of 18 nutritional combinations. The treatments constituted *viz*., Organic levels O_1- No Organics, O_2- 5 t Compost/ha, Plant populations P_1- 60 cm x 30 cm (55555 plant/ha), P_2- 60 cm x 45 cm (37037 plant/ha), P_3- 60 cm x 22.5cm (74074 plant/ha), Fertilizer levels F_1-100% NPK+S+ Limiting micro-nutrients, F_2-F_1 +25% higher NPK, F_3-F_1 + 33% higher NPK. The study revealed that significantly higher yield (q/ha) observed among the organic levels is O_2-5 t Compost i.e. 1925 kg/ha, among the plant populations (P3) 1946 kg/ha and among the Fertilizer levels (F3) 1927 kg/ha. In gross and net returns also follows similar trend and in B: C ratio also follows similar trend except in organic levels, in this O_1 recorded maximum B: C ratio.

Keywords: Economic yield, sunflower *Helianthus annuus* L.

Introduction
Sunflower gained importance and popularity as a commercial oilseed crop of India under rainfed conditions since its introduction during the seventies as an oilseed crop to India. This is due to its suitability to many agro ecological regions, short duration, good quality oil and market price. This crop is mainly grown in spring season but can be grown in any season of the year since this crop is considered as day neutral plant because of its low photoperiod sensitivity. Karnataka is the leading sunflower producing state in the country and accounts for nearly 52% of the total area and 40% of the total production in the country. In India, sunflower is grown over an area of 5.20 lakh hectares with a production and productivity of 3.35 lakh tons and 643 kg per hectare, respectively during the year of 2015-16 (Anon, 2017). Though the crop has gained an important place among farmers, the productivity of sunflower is very low. The low productivity is mainly due to the crop growing under rainfed conditions on poor fertility soils with non-availability of cultivars under moisture and nutrient stress situations. This crop is often considered as a soil nutrient depleting crop, which puts heavy demands on soil and applied nutrients (Thavaprakash *et al.*, 2002) [5]. Due to its high uptake of nutrients sunflower responds very well to applied nutrients. Application of nutrients increased the seed yield of sunflower by 50% (Chorey and Thosar, 1997). The NPK recommendation being advocated to farmers including in the package of practices were developed about 40 years back by the State Agricultural Universities (SAU"s) in collaboration with Indian Council of Agricultural Research (ICAR, New Delhi) and the developmental departments. These recommendations may not be of much relevance in the present day context, due to appreciable decline in fertility of soil all over the country. This has been amply demonstrated by the results obtained in All India Co-ordinated Research Project (AICRP) on Long Term Fertilizer Experiments (LTFE) studies conducted all over the country. These experiments have revealed that receiving 150 per cent of the recommended NPK recorded higher yield values than plots receiving 100 per cent recommended NPK and warrants the need for assessment of the package of practice recommendations for different crops including sunflower.

To achieve the highest yield potential of sunflower hybrid providing ideal or optimum geometry is through planting density. Plants spacing effects are highly pronounced in sunflower because there is no possibility of covering gaps between plants by branching or tillering. Thus, an optimum plant stand helps in harnessing the renewable resources in efficient manner towards achieving higher crop yields. Planting geometry determines distribution patterns of the plants in a field. It affects the evaporation, water use efficiency of the crop and weed intensity/competition. Proper spacing of plants in particular area makes canopy more effective in intercepting the radiant energy and shading effects on weeds (Saleem *et al.*, 2008) [4].

Materials and Methods

The field experiment was started during spring-2014-16 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 Calciorthent having pH 8.21, organic carbon 0.42%, available N 196 kg/ha, P_2O_5 14.8 kg/ha and K_2O 114.5 kg/ha. The crop was fertilized at the rate of 80 kg N, 90 kg P_2O_5 and 40 kg K_2O/ha in all the treatments. Nitrogen was applied through urea in two equal splits (sowing time, 30 DAS); P_2O_5 and K_2O were applied as single basal dose in the form of di ammonium 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. The experiment was laid out in Split plot design with 3 replications. The treatment comprised 2 (main) x 3 x 3 (sub) of 18 nutritional combinations. The treatments constituted *viz*., Organic levels O_1- No Organics, O_2- 5 t Compost/ha, Plant populations P_1- 60 cm x 30 cm (55555 plant/ha), P_2- 60 cm x 45 cm (37037 plant/ha), P_3- 60 cm x 22.5cm (74074 plant/ha), Fertilizer levels F_1-100% NPK+S+ Limiting micro-nutrients, F_2-F_1 +25% higher NPK, F_3-F_1 + 33% higher NPK. The observations were recorded on growth, yield attributes and yield. Costs and returns were computed based on the prevailing market price. The oil content of sunflower seed was estimated by using Nuclear Magnetic Resonance (NMR) method. The results were analyzed with suitable statistical procedures / method.

Table 1: Performance of sunflower as influenced by the application of organic matter, plant population and fertilizer levels (Pooled Analysis, 2013 – 2016).

Treatments	Plant height (cm)	Head diameter (cm)	100-seed weight (g)	Seed yield (kg/ha)	Oil content (%)	Oil yield (kg/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C ratio
Organic levels									
O_1- No Organics	145.93	16.6	4.79	1631	40.50	661	50838	37070	2.70
O_2- 5 t Compost/ha	170.94	19.4	5.10	1925	40.22	774	59419	42651	2.54
S Em+	0.30	0.30	0.09	15.60	0.24	25.63	636	636	0.07
CD (P=0.05)	1.83	NS	NS	NS	NS	NS	3860	NS	NS
Plant populations									
P_1- 60 cm x 30 cm (55555 plant/ha)	162.30	17.35	5.27	1800	41.27	743	55759	40491	2.65
P_2- 60 cm x 45 cm (37037 plant/ha)	167.92	21.15	6.52	1587	40.72	646	50079	35261	2.38
P_3- 60 cm x 22.5cm (74074 plant/ha)	159.58	18.95	5.93	1946	40.87	795	60538	44670	2.82
S Em+	1.40	0.20	0.10	55.68	0.31	19.55	866	864	0.07
CD (P=0.05)	4.02	0.57	0.28	217.43	NS	57.56	2396	2394	0.22
Fertilizer levels									
F_1-100% NPK+S+ Limiting micro-nutrients	160.24	17.1	5.12	1606	40.70	654	50145	13917	0.38
F_2-F_1 +25% higher NPK	162.31	19..45	5.43	1801	40.50	729	55803	17565	0.48
F_3-F_1 + 33% higher NPK	168.58	19.85	5.18	1927	40.62	783	59694	19728	0.50
S Em+	1.36	0.19	0.11	80.94	0.32	19.24	861	870	0.07
CD (P=0.05)	NS	0.55	NS	235.63	NS	NS	2346	2406	0.21

Result and Discussion

Yield and yield attributes

The pooled data on plant height had non-significantly varied among the treatments, data revealed that the maximum plant height observed in the treatments O2-5t compost/ha (170.94 cm) among the Plant populations P2- 60 cm x 45 cm (167.92 cm) and among the fertilizer levels F3- 133 % NPK(168.58 cm) found maximum and this treatment found at par with O1-No organics (145.93 cm), among the Plant populations P1-60 cm x30 cm (162.30 cm) and among the fertilizer levels F2-125 % NPK(162.31 cm). The data regarding the Head diameter found significant difference due to different treatments maximum Head diameter observed in the treatments O2-5t compost/ha (19.4 cm) among the Plant populations P2- 60 cm x 45 cm (21.15 cm) and among the fertilizer levels F3- 133 % NPK(19.85cm) found maximum

and this treatment found at par with O1-No organics (16.6 cm), among the Plant populations P3-60 cm x22.5 cm (18.95 cm) and among the fertilizer levels F2- 125 % NPK(19.45 cm). The data pertaining to the 100 seed weight found significant difference due to different treatments maximum 100 seed weight observed in the treatments O2-5t compost/ha (5.10 gm) among the Plant populations P2- 60 cm x 45 cm (6.52 gm) and among the fertilizer levels F2- 125 % NPK (5.43 gm) found maximum and this treatment found at par with O1-No organics (4.79 gm), among the Plant populations P3-60 cm x22.5 cm (5.93 gm) and among the fertilizer levels F3- 133 % NPK (5.18 gm). The study revealed that significantly higher yield (q/ha) observed among the organic levels is O_2-5 t Compost i.e. 1925 kg/ha, among the plant populations (P3) 1946 kg/ha and among the Fertilizer levels (F3) 1927 kg/ha and this was found at par with O1-No organics (1631 kg/ha), among the Plant populations P1-60 cm x30 cm (1800 kg/ha) and among the fertilizer levels F2 -125 % NPK(1801 kg/ha). The study revealed that had non - significantly oil content (%) observed among the organic levels is O1-No Organics i.e. 40.50 %, among the plant populations (P1)41.27 % and among the Fertilizer levels (F1) 40.70 % and this was found at par with O2-5 t compost /ha (40.22 %), among the Plant populations P3-60 cm x22.5 cm (40.87 %) and among the fertilizer levels F3 -133 % NPK (40.62 %).

Economics

The data regarding net returns had significant influence due to different treatments, maximum net returns recorded in organic levels O2-5t compost/ha(42,651rs/ha), in plant population treatments the P3 -60cm x 22.5cm (44,670rs/ha) and among fertilizer levels F3 -133% NPK(19,728rs/ha), this was found to be at par with the treatment in organic levels O1- no organics (37,070rs/ha), in plant population P1 60cm x 30cm(40,491rs/ha) and among fertilizer levels F2-125% NPK (17, 565rs/ha) and data pertaining BC ratio had significant influence due to different treatments maximum B:C ratio recorded in organic levels O1-no organics(2.70), in plant population treatments the P3 -60cm x 22.5cm (2.82) and among fertilizer levels F3 -133% NPK(0.50), this was found to be at par with the treatment in organic levels O2-5t compost/ha (2.54), in plant population P1 60cm x 30cm (2.65) and among fertilizer levels F2-125% NPK(0.48).

Seed yield of sunflower increased significantly with subsequent increase in fertilizer levels and recorded maximum seed yield at 133% of RDF. Similarly, incorporation of 5t compost/ha recorded 18.03% higher seed yield than control (no-organics) but difference was not found to be significant. Seed yield of sunflower also varied significantly among the population density. 33% higher plant population recorded highest seed yield which was significantly higher than lower plant population but was found at par with recommended plant population. Net return and B:C ratio did not varied significantly among the organic levels. 33% higher than the recommended plant population recorded significantly higher net return and B:C ratio than the recommended and lower than the recommended plant population. Recommended plant population also recorded significantly higher net return and B:C ratio over lower plant population. Net return and B:C ratio also increased with increasing levels of fertilizers, but significant increase was recorded only up to 100% NPK + S + Micronutrient + 25% higher NPK levels of fertilizer.

Recommendation based on concluded trials: 33% higher plant population and 100% NPK + S + Micronutrient + 25% higher NPK were found ideal for enhancing the productivity and profitability of sunflower under North Bihar condition.

References

1. Murad Ali Khan and Mohammad Akmal. Plant arrangement effect on the sunflower yield and yield traits in spring season crop. Sarhad Journal of Agriculture. 2016; 32(3):151-155.
2. Osman EBA, Awed MMM. Response of Sunflower (*Helianthus Annuus* L.) to Phosphorus and Nitrogen Fertilization under different Plant Spacing at new valley. *Associate University Bulletin Environmental Resources*, 2010, 13(1).
3. Poonia KL. Effect of planting geometry, nitrogen and sulfur on growth and yield of sunflower (*Helianthus annuus* L.). Journal of Eco-Physiology. 2000; 3(1&2):59-71.
4. Saleem MF, Ma BL, Malik MA, Cheema MA, Wahid MA. Yield and quality response of autumn-planted sunflower (*Helianthus annuus* L.). to sowing dates and planting patterns. Canadian Journal of Plant Science. 2008; 88:101-109.
5. Thavaprakash N, Siva Kumar SD, Raja K, Senthil Kumar G. Effect of Nitrogen and Phosphorus levels and ratios on seed yield and nutrient uptake of Sunflower hybrid DSH-1, 2002; 25:59-68.
6. Ullasa MY, Sheshadri T, Geetha KN, Shankarlingappa BC Standardization of best management practices of yield maximization of sunflower (*Helianthus annuus* L). *HELIA* 2013; 36(58):95-100.