



Original Research Article

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Efficacy of Hydrophilic Polymer on Sunflower (*Helianthus annus L.*) Production in Spring

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An experiment was carried out at research farm at T.C.A. Dholi, Muzaffarpur (Bihar) during Spring season of 2016-17, to study the efficacy of hydrophilic polymer on sunflower production. The experiment was laid out in randomized block design with 3 replications. The experiment was comprised of a total of 7 hydrophilic combinations,. Sunflower hybrid KBSH-44 was used and among the hydrophilic substrates hydrogel and humic acid were applied @2.5kg/ha, while vermi compost @ 2.5t/ha and fly ash @ 2.0t/ha. Irrigation was provided based on calculation of available soil moisture. The results emphasized that application of FYM, hydrogel, vermicompost or humic acid along with RDF for nutrient supply and as source of moisture conservation have resulted in higher values of, head diameter, oil content and 100 seed weight compared to sole application of 100% RDF. The two - year spring season data also revealed that the seed yield and oil content of sunflower was influenced significantly by the combined effect of moisture conservation and nutrient source. Though magnitude of soil moisture variation was small, all the hydrophilic substrates maintained higher soil moisture compared to use of RDF only. The results of two - year experiments indicated that adoption of moisture conservation techniques through use of polymer hydrogel and application of organics like FYM or vermicompost are proved to be suitable from the point of both moisture retention as well as source of nutrients for nutrient exhaustive crop like sunflower.

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). 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 critical analysis of production factors to increase the productivity of sunflower under different agro ecological situations of India revealed that moisture and nutrient are the key inputs to realize higher and sustainable production of sunflower cultivars under rainfed conditions. The rainfed farmers are resource poor and identification of best agronomic practices suited to moisture and nutrient stress conditions are vital. Hydrophilic polymers like hydrogel have capability to store extra water in soil that enables crop to utilize the water over an extended period of time. Application of humic acid, fly ash and organic matter either through farmyard manure or vermicompost have been shown to increase CEC and improve soil texture and porosity leading to retention of higher soil moisture in the soil. FYM/ vermicompost in addition to moisture retention they act as nutrient sources also.

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 $25^{\circ} 59' N$ latitude and $85^{\circ} 35' E$ 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 $7.9^{\circ}C$, respectively. The soil was Calcorthent 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 experiment was laid out in Randomized Block Design (RBD), replicated thrice within a plot and involved 7 treatments. 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 with spacing of 60 cm \times 30 cm. The potential sunflower hybrid, KBSH -44 was used with seven treatments viz., T1: RDF, T2: RDF + 5t FYM/ha spreading across field, T3: RDF + 2.5t FYM/ha in seed furrows, T4: RDF + Hydrogel @ 2.5kg/ha in seed furrows, T5: RDF + Humic acid @ 2.5 kg/ha in seed furrows, T6: RDF + Vermicompost @ 2.5t/ha in seed furrows and T7: RDF + Fly ash @ 2t/ha in seed furrows. 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.

Results and Discussion

Yield and yield attributes

The data revealed that during spring seasons of 2016 and 2017 (pooled) application of RDF + 2.5t FYM/ha in seed furrows(T3) resulted in highest head diameter (15.76cm) followed by (T4) RDF + Hydrogel @ 2.5kg/ha in seed furrows (15.38cm), (T2) RDF + 5t FYM/ha spreading across field (15.34 cm), (T6) RDF + Vermi compost @ 2.5 t/ha in seed furrows (14.66 cm), (T7) RDF + Fly ash @ 2.0 t/ha in seed furrows (14.17 cm), (T1) RDF (14.15 cm) and the lowest head diameter observed in (T5) RDF + Humic acid @ 2.5 kg/ha in seed furrows. (14.13cm). In the plant height RDF + 2.5t FYM/ha in seed furrows(T3) resulted in highest in plant height (178 cm) followed by followed by (T4)RDF + Hydrogel @ 2.5kg/ha in seed furrows (177 cm), (T2) RDF + 5t FYM/ha spreading across field (169 cm), (T1) RDF (168cm), (T7) RDF + Fly ash @ 2.0 t/ha in seed furrows (167 cm), (T5) RDF + Humic acid @ 2.5 kg/ha in seed furrows (161), and the lowest in (T6)RDF + Vermi compost @ 2.5 t/ha in seed furrows.(157 cm). The results emphasize that application of FYM, hydrogel, vermicompost or humic acid along with RDF for nutrient supply and as source of moisture conservation have resulted in higher values of, head diameter, oil content and 100 seed weight compared to sole application of 100% RDF (T1). The two - year rainy season data (Table 1) also revealed that the seed yield and oil content of sunflower was influenced significantly by the combined effect of moisture conservation and nutrient source. The yield of the crop revealed that (T2) RDF + 5t FYM/ha spreading across field (1793 kg

/ha) followed by (T7) RDF + Fly ash @ 2.0 t/ha in seed furrows (1765 kg/ha), (T3) RDF + 2.5t FYM/ha in seed furrows (1682 kg/ha), (T6) RDF + Vermi compost @ 2.5 t/ha in seed furrows. (1638 kg/ha), (T4) RDF + Hydrogel @ 2.5kg/ha in seed furrows (1621 kg/ha), (T1) RDF (1553 kg /ha), and lowest in (T5) RDF + Humic acid @ 2.5 kg/ha in seed furrows (1366 kg /ha), Significantly higher oil content was observed with T3: RDF + 2.5t FYM/ha in seed furrows (41.81%) followed by (T6) RDF + Vermi compost @ 2.5 t/ha in seed furrows. (41.72 %), and lowest observed in (T2) RDF + 5t FYM/ha spreading across field (40.95 %). This might be due to rainfall occurred during flowering which has caused pollen wash thereby reducing the oil content. The data regarding oil yield found that (T2) RDF + 5t FYM/ha spreading across field (733 kg /ha) followed by (T7) RDF + Fly ash @ 2.0 t/ha in seed furrows(728 kg /ha) and lowest oil yield in (T5) RDF + Humic acid @ 2.5 kg/ha in seed furrows(565 kg/ha). In 100 seed weight data revealed that (T2) RDF + 5t FYM/ha spreading across field (4.94 g) followed by (T3) RDF + 2.5t FYM/ha in seed furrows (4.78 g) and the lowest in (T4) RDF + Hydrogel @ 2.5kg/ha in seed furrows (3.83 g).

Economics

The pooled data pertaining to the gross returns, net returns and B:C Ratio. The highest gross returns in (T2) RDF + 5t FYM/ha spreading across field (66490 Rs /ha) and lowest in (T5) RDF + Humic acid @ 2.5 kg/ha in seed furrows (50642 Rs/ha). The highest net returns obtained in the (T2) RDF + 5t FYM/ha spreading across field (40575 Rs /ha) compared to other treatments and lowest net returns in (T5) RDF + Humic acid @ 2.5 kg/ha in seed furrows(25547 Rs/ha). Similarly the highest B:C ratio in (T2) RDF + 5t FYM/ha spreading across field (1.57) followed by (T1) RDF (1.49).

Table.1 Efficacy of hydrophilic polymer on Sunflower production in Dholi (2016- 2017, Pooled data)

TREATMENTS		Plant height (cm)	Head diameter (cm)	100 seed wt. (g)	Seed yield (kg/ha)	Oil content (%)	Oil yield (kg/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C ratio
T ₁	RDF	168	14.15	4.23	1553	41.43	643	57510	34425	1.49
T ₂	RDF + 5t FYM/ha spreading across field.	169	15.34	4.94	1793	40.95	733	66490	40575	1.57
T ₃	RDF + 2.5t FYM/ha in seed of furrows.	178	15.76	4.78	1682	41.81	704	62366	36451	1.41
T ₄	RDF + Hydrogel @ 2.5 kg/ha in seed furrows.	177	15.38	3.83	1621	41.27	669	60057	32062	1.14
T ₅	RDF + Humic acid @ 2.5 kg/ha in seed furrows.	161	14.13	4.48	1366	41.45	565	50642	25547	1.02
T ₆	RDF + Vermicompost @ 2.5 t/ha in seed furrows.	157	14.66	4.51	1638	41.72	683	60667	27332	0.82
T ₇	RDF + Fly ash @ 2.0 t/ha in seed furrows.	167	14.17	4.50	1765	41.23	728	65411	37621	1.35
SEM±		1.21	0.87	0.30	69.77	0.36	28.83	2600	2594	0.10
CD (P = 0.05)		3.77	NS	NS	217.22	NS	85.83	7763	8076	0.32

The higher gross returns, net returns and B:C ratio of moisture conservation and nutrient sources might be due to higher seed yield coupled with higher market price.

In conclusion, the results of two-year experiment indicated that adoption of moisture conservation techniques through use of polymer hydrogel and application of organics like FYM or vermicompost are proved to be suitable from the point of both moisture retention as well as source of nutrients for nutrient exhaustive crop like sunflower. The higher quantities of soil moisture retained by the hydrophilic substrates provide extra available water to

crops which facilitates better crop growth. More available water in the soil also means less frequent irrigation. Use of hydrophilic substrates helps in reducing the crop water requirements marginally and thus will address the adversities of climate change.

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