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Response of sunflower (*Helianthus annuus* L.) to different mulching and moisture conservation practices

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Abstract
A field experiment was carried out at Experimental Farm, College of Agriculture, Vasantrao Naik Krishi Vidyapeeth, Latur to study the response of sunflower to different mulching and moisture conservation practices during the year of 2014-2015. The experiment field was uniform and levelled. The soil was clay loam in texture, low in available nitrogen, medium in available phosphorus, high in available potash and alkaline in reaction. The mean rainfall during crop growth period is 341.4 mm and 25 rainy days. The months of July, August and September were humid and moisture index is positive. However the rest of the period is dry. Long dry spell observed during the growth period. Gross plot size was 5.4 m x 4.2 m and net plot size was 4.2 m x 3.6 m. There were seven treatments which replicated three times in Randomised Block Design. The treatments were No mulching, Straw mulching, Dust mulching, Incorporation of FYM in soil@5t $ha^{-1.}$, Opening of alternate furrows(30DAS), Opening of furrows after four rows, and In situ weed mulching. The sowing of crop was done on 13th July 2014 by dibbling method at 30 x10 cm spacing and harvesting was done on 20th October 2014.The opening of alternate furrows (30DAS) recorded higher plant height(153.2cm), number of functional leaves $plant^{-1}$(24.3),dry matter $plant^{-1}$ (153g), head diameter (18.2cm), leaf area index (3.27), percent filled seeds (83.9) and seed yield (1497 kg ha^{-1}).

Keywords: Sunflower, mulching, in-situ conservation, growth, yield

1. Introduction
In recent years, sunflower (*Helianthus annuus* L.) has become an important oilseed crop of Maharashtra, India particularly in the Marathwada region. Sunflower is one of the fastest growing oilseed crop. It is more important oilseed crop as it has the quality of short duration, photosensitivity and wild adaptability to different agro climatic regions and soil type. Most important growing states of sunflower in India are Karnataka, Andhra Pradesh, Maharashtra and Tamil Nadu. In India the area under sunflower crop was 0.69 mha^{-1} and production was, 0.55 mt with the productivity of 791 kg ha^{-1}. In Maharashtra, sunflower is cultivated on an area of 61 thousand $ha^{-1}$and production was 38 thousand tones with the productivity of 623 kg per ha^{-1}. In Marathwada region of the state accounts about 50 thousand ha of area, 30 thousand tonnes of production and 602 kg ha^{-1} productivity compared to state. The sunflower grown in Latur, Nanded, and Parbhani districts of Marathwada region in Maharashtra. Its oil is of high quality as it contains oleic, linoleic acid, non-cholesterol properties therefore it is recommended for the heart patients. Oil and protein content of sunflower are respectively 40 – 45% and 14 – 19%. Its oil also have sufficient amount of calcium, iron and vitamin like A, D, E and B complex. The importance of sunflower as an oilseed crop in India is of very recent origin and date backs to three decades. But its contribution towards attaining self-sufficiency in edible oil as well as to “yellow revolution" in the country is noteworthy. Straw mulch helps to retain soil moisture, reduce temperature, and conserve soil, control weeds and increase soil fertility (Dushouyu *et al*., 1995) [4]. Mulches increase the soil moisture in root zone and significantly decrease soil temperature. This provides a more stable environment for seedling establishment and growth than un mulched soil (Osuiji, 1990) [7]. Moreover, mulches increase infiltration and storage of water in the rhizosphere, improve structure and macro-porosity of soil along with reducing runoff and evaporation losses (Acharya and Kapur, 1993) [1]. Moisture is being the most limiting factor for growth and development. Moisture conservation is the best advantageous to crop plant. Surkod and Itnal (1998) [5] have observed higher soil moisture content due to compartment bunding while Selvaraju *et al*., (1999) [6] reported similar views due to adaptation of tied ridges and furrows and compartment bunding as compared to flat bed method.

2. Material sand Methods

A field experiment was conducted at Experimental Farm of Agronomy section, College of Agriculture, Latur during *kharif* season of 2014 on sunflower hybrid (PAC334) to study the response of sunflower (*Helianthus annuus* L.) to different mulching and moisture conservation practices. The soil was clay loam in texture, low in available nitrogen (118.86) medium in available phosphorus (20.42), high in available potash (385.89) and alkaline in reaction(8.17pH). The mean rainfall during crop growth period is 341.4 mm and 25 rainy days. The months of July, August and September were humid and moisture index is positive. The trial was laid out in a Randomized Block Design with seven treatments were replicated thrice. The soil of the experimental plot was black in colour, deep with good drainage capacity. Topography was uniform and levelled. The crop was sown by dibbling method and used the seed rate of 5 kg $ha^{-1.}$ Sowing of seed was done in second week of July Optimum spacing used for sunflower crop was 1800 cm^2. The recommended dose of fertilizer (90:60:60 NPK kg ha^{-1}) applied through Urea, Single Super Phosphate and Murat of potash. The seven treatments were T_1 - No mulching, T_2 - Straw mulching, T_3 - Dust mulching, T_4 - Incorporation of FYM in soil@5t $ha^{-1.}$, T_5 - Opening of alternate furrows (30DAS), T_6 - Opening of furrows after four rows, T_7 – In situ weed mulching. The Gross plot size was 5.4 m x 4.2 m and net plot size was 4.2 m x 3.6 m.

3. Results and Discussion

Data pertaining to growth attributes is presented in Table 1 the maximum plant height of plant (153.2 cm) was recorded due to opening of alternate furrows (30 DAS) but which is did not found significantly superior to rest of the treatments. (Gawand *et al*., 2005) [2] The higher leaf area index (3.27) also found by applying opening of alternate furrows (30 DAS) (T5). The opening of alternate furrows (30 DAS) (T5) was recorded higher no. of functional leaves and at par with the treatment opening of furrows after fourrows (T_6), In situ weed mulching (T_7) and Incorporation of FYM in soil @ 5 t ha^{-1}(T_4) and remaining treatment found significantly superior over the rest of the treatments. The application of opening of alternate furrows (30 DAS) (T_5) was obtained higher stem girth (8.64 cm) and at par with opening of furrows after fourrows (T_6), Dust mulching (T_3), Straw mulching(T_2) and found significantly superior over the rest of the treatments (Reddy *et al*., 2005) [8] The maximum head diameter (18.2 cm) and dry matter (153g) were observed significant due to the application of opening alternate furrows (30 DAS) (T_5) and which was at par with the all treatment except No mulching (T_1). The maximum soil moisture per cent obtained when the application of opening alternate furrows (30 DAS) than other moisture conservation practices and which was at par with opening of furrows after fourrows (T_6) and Straw mulching (T_2) and significantly superior over the rest of the treatments.

Data presented in Table 2 revealed that, yield parameters of sunflower crop was influenced by different treatments. The higher no. of filled seeds $head^{-1}$ (755) was recorded due to the application opening of alternate furrows (30 DAS) (T_5) which was at par with opening of furrows after furrows(T_6) and Straw mulching(T_2) and significantly superior over the rest of the treatments. The maximum per cent of filled seeds (83.9), harvest index (20.19%), seed yield (1497 kg ha-1) (Tunio *et al*., 2007) [9] and oil content (33.90%) due to the application of opening of alternate furrows (30 DAS) (T_5) and found significantly superior over the rest of the treatments except oil content which is not found significantly superior over the rest of the treatments. Due to the application of opening of furrows after furrows (T_6) higher stalk yield (5929 kg ha-1) was observed and found at par with all treatments except No mulching (T_1). The higher test weight (50.33 g) were recorded significsnt due to the application of opening of alternate furrows (30 DAS) (T_5) and which was at par with In situ weed mulching (T_7), opening of furrows after four rows(T_6) and Straw mulching (T_2) (Panda *et al*., 2009) [3].

Table 1: Growth attributes influenced by different soil moisture conservation practices

Treatments	Height of Plant (cm)	No. of functional leaves	Leaf area index	Stem Girth (cm)	Head diameter (cm)	Dry matter (g)	Soil moisture (%)
T_1- No mulching	140.1	18.4	2.42	6.43	14.3	117	20.90
T_2- Straw mulching	153.1	24.1	2.89	8.14	18.01	147	24.10
T_3- Dust mulching	145.7	21.4	2.63	7.75	17	133	21.36
T_4- Incorporation of FYM in soil@5t/ha	146.4	21.6	2.64	7.31	17.3	135	22.64
T_5- Opening of alternate furrows (30DAS)	153.2	24.3	3.27	8.64	18.2	153	26.95
T_6-Opening of furrows after four Rows	148.00	23.2	2.82	7.73	17.6	143	23.65
T_7- In situ weed mulching	145.0	22.2	2.74	7.21	17.4	137	23.21
SE+	7.65	1.05	-	0.397	0.74	6.64	1.11
CD	NS	3.25	-	1.222	2.29	20.45	3.40

Table 2: Yield attributes influenced by different soil moisture conservation practices

Treatments	No of filled seeds $head^{-1}$	Percent of filled seeds	Test weight (g)	Stalk yield (kg/ha)	Harvest Index (%)	Seed yield (Kg/ha)	Oil content (%)
T_1- No mulching	565	75.6	48.37	4623	17.62	989	30.34
T_2- Straw mulching	677	80.7	50.17	6037	19.62	1474	32.59
T_3- Dust mulching	589	77.4	48.62	5434	17.90	1185	31.29
T_4- Incorporation of FYM in soil @5t/ha	631	79.1	48.77	5634	18.66	1293	32.09
T_5- Opening of alternate furrows (30DAS)	755	83.9	50.33	5916	20.19	1497	33.90
T_6-Opening of furrows after four Rows	664	81.0	49.37	5929	19.56	1442	33.85
T_7- In situ weed mulching	631	79.0	49.17	5734	18.90	1337	31.96
SE+	36	-	0.380	259	-	45	1.286
CD	110	-	1.170	799	-	138	NS

4. Conclusion

Among the moisture conservation practices, opening of alternate furrows 30 days after sowing performed better and gave the higher seed yield. Based on these findings it can be concluded that opening of opening of alternate furrows (30DAS) showed better soil moisture conservation and produced higher seed yield.

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