



Effect of Integrated Nutrient Management Practices on Yield Attributes and Nutrient Content and Uptake in Sunflower (*Helianthus annuus* L.) under Nagaland Condition

Boduvelu Rhakho¹, Rekha Yadav¹, D. Nongmaithem¹, Lanunola Tzudir¹, N. Kikon¹

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ABSTRACT

Background: Sunflower is an important oilseed crop. At present, the production of sunflower crop is less due to poor nutrient management practices. Excessive use of chemical fertilizers not only increases the cost of production but also leads to deterioration of soil and human health. The integrated use of nutrients from fertilizer and organic manure sources seems to be the need of the hour. Thus, integrated nutrient management holds great promise in meeting the growing nutrient demand of modern agriculture.

Methods: A pot experiment was conducted during pre-kharif season (March-June) of 2022 to study the effect of integrated nutrient management on growth, yield and quality of Sunflower. The experiment was laid out in Completely Randomized Design with three replications and consisted of seven treatments viz., T₁, T₂, T₃, T₄, T₅, T₆ and T₇.

Result: T₇ (FYM 10 t ha⁻¹ + 100% RDN) recorded highest in yield attributing characters i.e., head diameter (14.50 cm), number of seeds head⁻¹ (783.33), seed yield (26.67 g pot⁻¹) and stover yield (48.33 g pot⁻¹). Maximum NPK uptake for both seed and stover was recorded highest in FYM @ 10 t ha⁻¹ + 100% RDN. Maximum available soil N was recorded in T₇(FYM @ 10 t ha⁻¹ + 100% RDN) with 328.96 kg ha⁻¹ while maximum available soil P and K was recorded in T₂ {100% RDF (60:40:60) kg ha⁻¹} with 29.25 kg ha⁻¹ and 230.79 kg ha⁻¹, respectively.

Key words: Growth parameters, Seed yield, Stover yield, Sunflower.

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is an important oilseed crop derived from the Greek word 'helios' meaning 'sun' and 'anthos' meaning 'flower'. It is an annual plant which is native to America and probably originated in South-West Asia (Heiser, 1976). As the name itself suggest, it always follows the sun by day turning towards its direct rays and so has its name derived from the flower's shape and image which is often used to depict the sun. The area under sunflower in India is about 4.006 lakh hectares and the total production is about 2.840 lakh tonnes and productivity of 709 kg ha⁻¹. In Nagaland, it is grown in an area of 2730 hectares with a production of 1770 metric tonnes (Statistical Handbook of Nagaland, 2021). Sunflower has gained popularity among all the oilseed crops because of its excellent quality oil with high degree polyunsaturated fatty acids, anti-cholesterol properties, short duration, wide adaptability to soil and climatic conditions, photo and thermos-insensitiveness, drought tolerance and higher oil yield per unit area (Thimmegowda *et al.*, 2007). It is the fourth oil seed crop grown worldwide by area. (Koutroubas *et al.*, 2008). Sunflower oil is generally considered premium oil because of its light colour, bland flavor, high smoke point, low in saturated fats, neutral taste, good keeping quality and ideal for cooking. Sunflower seeds contain high percentage of polyunsaturated fatty acids including linoleic acid (72.5%) and oleic acid (16%) which reduce the cholesterol in blood (Patra *et al.*, 2013; Amirian *et al.*, 2013). Oil cake is rich in high quality protein and is can be used

¹Department of Agronomy, School of Agricultural Sciences, Nagaland University, Medziphema-797 106, Nagaland, India.

Corresponding Author: Rekha Yadav, Department of Agronomy, School of Agricultural Sciences, Nagaland University, Medziphema-797 106, Nagaland, India. Email: rekha25yadav@gmail.com

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as cattle and poultry feed. Sunflower hulls are also used in animal feeds as a source of roughage. Sunflower is also as bio-diesel or vegetable-based fuel for running many machineries.

Among the nutrients, nitrogen plays an important role in increasing the productivity of sunflower. It being a major essential element responsible for increasing the photosynthetic surface area and in turn increases the translocation of photosynthates to sink which results in increase in productivity. Nitrogen is an essential nutrient for plant growth as it being the principle constituent of proteins, enzymes, hormones, vitamins, chlorophyll, *etc.* It is said that of all the nutrient elements required by plants, nitrogen is most essential and is required in the largest amount from soil (Lewis, 1986). Nitrogen is essential for

all life processes in plants (Laegreid, 1999) being a vitally important plant nutrient and most frequently deficient among all nutrients (Tisdale *et al.*, 2003).

MATERIALS AND METHODS

The pot experiment was conducted in Agronomy Department of School of Agricultural Sciences, Medziphema during pre-kharif season, 2022. It is situated at an altitude of 310 m above mean sea level with geographical location at 20°45'43"N latitude and 95°53'04"N longitudes. The climate in the experimental farm represents humid and sub-humid climate zone with high relative humidity with an average rainfall of 2000-2500 mm starting from April and ends in September while the period from October to March remains comparatively dry. Temperature during summer ranges from 21°C to 32°C and rarely goes below 8°C in winter due to high atmospheric pressure. KBSH-44: Released in the year 2002 and developed by AICRP (Sunflower) Centre, University of Agricultural Sciences, Bengaluru was used for this study. This variety has a mean yield of 1500-1800 kg ha⁻¹ and potential yield of 2200-2800 kg ha⁻¹ with a duration of 90-95 days. The variety was tested for the first time in Nagaland condition. The experiment was laid out in completely randomized design (CRD) with three replications and 7 treatments viz., T₁ : Control, T₂ : 100% RDF (60:40:60) kg ha⁻¹, T₃ : FYM @ 2 t ha⁻¹ + 100% RDN, T₄ : FYM @ 4 t ha⁻¹ + 100% RDN, T₅ : FYM @ 6 t ha⁻¹ + 100% RDN, T₆ : FYM @ 8 t ha⁻¹ + 100% RDN and T₇ : FYM @ 10 t ha⁻¹ + 100% RDN. The fertilizers NPK were applied at the rate of 60, 40 and 60 kg respectively in the form of urea, single super phosphate and muriate of potash while organic manure were applied @ 2, 4, 6, 8 and 10 t ha⁻¹ 15 days prior to sowing as per the dose recommended for each pot to facilitate the process of thorough decomposition of organic nutrient supply to the crop. The manure was properly incorporated into the pots by removing a portion of the top soil in the pot to allow proper incorporation. The soil to be put in the pot was ploughed well and made free of stubbles, debris and other unwanted plant material then 12 kg of soil was weighed and filled

into the pots. The soil inside the pots was then levelled and the pots were arranged as per the experimental layout. The fertilizers NPK was applied at the rate of 60, 40 and 60 kg ha⁻¹, respectively in the form of urea, single super phosphate (SSP) and muriate of potash (MOP). Seeds were sown at a depth of 5 cm in each pot. The soil of the experimental site was well drained and sandy loam in texture. The soil was found to be acidic in pH (4.5), high in organic carbon (1.06 %), low in available nitrogen (252.16 kg ha⁻¹), medium in available phosphorous and potassium (22.51 kg ha⁻¹ and 169.15 kg ha⁻¹, respectively). To ascertain the texture and fertility status of the soil, soil sample was collected in V method from the pot with the help of *khurpi* at a depth of 15-20 cm.

RESULTS AND DISCUSSION

Yield attributes

The data was recorded and analyzed for yield attributes of sunflower in Table 1. Among the various treatment, T₇ (FYM @ 10 t ha⁻¹ + 100% RDN) recorded largest size of head (14.50 cm) which was statistically at par with treatments T₂ {100% RDF (60:40:60) kg ha⁻¹}, T₆ (FYM @ 8 t ha⁻¹ + 100% RDN), T₅ (FYM @ 6 t ha⁻¹ + 100% RDN) and T₄ (FYM @ 4 t ha⁻¹ + 100% RDN). Increase in seed size could be due to better translocation of photosynthates to sink portion due to good availability of all the nutrients. Similar findings were reported by Awasthi *et al.* (2011). The minimum number of seeds head⁻¹ (344.67) were observed in T₁ (Control) where nutrients were not applied whereas maximum number of seeds head⁻¹ (783.33) were found in T₇ (FYM @ 10 t ha⁻¹ + 100% RDN) which was found to be statistically at par with the treatments T₂ {100% RDF (60:40:60) kg ha⁻¹}, T₆ (FYM @ 8 t ha⁻¹ + 100% RDN) and T₅ (FYM @ 6 t ha⁻¹ + 100% RDN). This result is in accordance with the findings of Kalaiyaran and Vaiyapuri (2008). In the same table, maximum yield (26.67 g pot⁻¹) was observed in T₇ (FYM @ 10 t ha⁻¹ + 100% RDN) which was statistically at par with T₂ {100% RDF (60:40:60) kg ha⁻¹}. Increase in seed yield was observed with higher dose of FYM (10 t ha⁻¹) along with 100% RDN as compared to lower dose of FYM (2,4,6,8 t

Table 1: Effect of integrated nutrient management on yield attributes of sunflower.

Treatment	Head diameter (cm)	Number of seeds head ⁻¹	Seed yield (g pot ⁻¹)	Stover yield (g pot ⁻¹)	Harvest index (%)
T ₁	9.03	344.7	8.3	23.8	25.9
T ₂	14.3	762.7	24.7	46.7	34.8
T ₃	12.3	530.0	16.1	31.7	33.7
T ₄	13.2	646.3	19.9	39.2	33.9
T ₅	13.4	728.7	21.8	43.9	33.9
T ₆	13.6	734.3	23.0	44.7	34.0
T ₇	14.5	783.3	26.7	48.3	36.1
SEm±	0.50	27.79	0.84	2.03	1.95
CD (p=0.05)	1.53	84.29	2.56	6.16	5.90

ha⁻¹) in combination with 100% RDN. Similar findings were reported by Mohammadi *et al.* (2012). Maximum stover yield (48.33 g pot⁻¹) was recorded in T₇ (FYM @ 10 t ha⁻¹ + 100% RDN) which was statistically at par with treatment T₂ {100% RDF (60:40:60) kg ha⁻¹}, T₆ (FYM @ 8 t ha⁻¹ + 100% RDN) and T₅ (FYM @ 6 t ha⁻¹ + 100% RDN). Similar findings were reported by Dambale *et al.* (2018). Highest harvest index (36.14%) was also recorded in T₇ (FYM @ 10 t ha⁻¹ + 100% RDN) and found statistically at par with all the remaining treatments except T₁ (Control).

Nutrient uptake

The data analyzed on nutrient uptake of crop was tabulated in Table 2. The highest N uptake by seed was recorded in T₇ (FYM @ 10 t ha⁻¹ + 100% RDN) with 880.72 mg pot⁻¹ while T₁ (Control) recorded the lowest N uptake with 227.88 mg pot⁻¹. The highest N uptake by stover was recorded in T₇ (FYM @ 10 t ha⁻¹ + 100% RDN) with 375.09 mg pot⁻¹ while T₁ (Control) recorded the lowest N uptake with 100.82 mg pot⁻¹. Similar finding was reported by Hao and Chang (2002).

The highest P uptake by seed was also recorded in T₇ (FYM @ 10 t ha⁻¹ + 100% RDN) with 249.81 mg pot⁻¹ which was statistically at par with T₂ {100% RDF (60:40:60) kg ha⁻¹} while T₁ (Control) recorded the lowest P uptake with 48.35 mg pot⁻¹. The highest P uptake by stover was recorded in T₇ (FYM @ 10 t ha⁻¹ + 100% RDN) with 166.34 mg pot⁻¹

which was statistically at par with T₂ {100% RDF (60:40:60) kg ha⁻¹} while T₁ (Control) recorded the lowest P uptake with 41.87 mg pot⁻¹.

While the highest K uptake by seed was recorded in T₇ (FYM @ 10 t ha⁻¹ + 100% RDN) with 246.31 mg pot⁻¹ which was statistically at par with T₂ {100% RDF (60:40:60) kg ha⁻¹} while T₁ (Control) recorded the lowest K uptake with 42 mg pot⁻¹. The highest K uptake by stover was recorded in T₇ (FYM @ 10 t ha⁻¹ + RDN 100% kg ha⁻¹) with 509.71 mg pot⁻¹ while T₁ (Control) recorded the lowest K uptake with 178.95 mg pot⁻¹.

Available soil nutrients

After harvest of crop, soil was analysed for available soil nutrient and data was analyzed and tabulated in (Table 3). Highest available soil N was recorded in T₇ (FYM @ 10 t ha⁻¹ + 100% RDN) with value 328.96 kg ha⁻¹ while the lowest soil available N was recorded in T₁ (Control) with value 169.24 kg ha⁻¹. Higher available nitrogen in the soil could be attributed to higher rate of mineralization of organic nitrogen in the soil. Similar finding was reported by Thimmegowda *et al.* (2007).

The available P in soil was maximum in 100% RDF (60:40:60) kg ha⁻¹ with value 29.25 kg ha⁻¹ while T₁ (Control) recorded lowest soil available P with value 16.98 kg ha⁻¹. As for K, highest available soil K was recorded in 100% RDF (60:40:60) kg ha⁻¹ with value 181.89 kg ha⁻¹. The lowest

Table 2: Effect of integrated nutrient management on nutrient uptake of sunflower.

Treatment	N (mg pot ⁻¹)		P (mg pot ⁻¹)		K (mg pot ⁻¹)	
	Seed	Stover	Seed	Stover	Seed	Stover
T1	227.88	100.82	48.35	41.87	42.00	178.95
T2	806.90	329.27	244.71	164.64	235.20	498.28
T3	491.71	165.59	135.47	69.78	118.42	275.79
T4a	626.40	216.21	169.91	91.65	151.44	380.65
T5	688.56	260.92	192.57	117.20	183.78	429.72
T6	748.46	279.63	213.90	148.74	207.71	461.15
T7	880.72	375.09	249.81	166.34	246.31	509.71
SEm±	27.91	18.03	7.78	7.61	7.95	22.54
CD (p=0.05)	84.67	54.68	23.59	23.07	24.10	68.37

Table 3: Effect of integrated nutrient management on soil available nutrient of sunflower.

Treatment	N (kg ha ⁻¹)	P (kg ha ⁻¹)	K (kg ha ⁻¹)
T1	169.24	16.98	134.40
T2	249.02	29.25	230.79
T3	217.89	22.50	170.10
T4	221.22	23.01	173.12
T5	255.40	23.32	175.50
T6	284.56	23.37	178.37
T7	328.96	23.39	181.89
SEm±	2.75	0.15	1.26
CD (p=0.05)	8.35	0.44	3.81

soil available K was recorded in T₁ (Control) with value 134.40 kg ha⁻¹.

CONCLUSION

From the present investigation it may be concluded that crop yield and nutrient uptake improved upon integrated use of organic manure along with fertilizer. Higher dosage of manure was found to be more beneficial for crop growth when used in conjunction with nitrogen. As nitrogen forms as an essential nutrient being the key component of amino acids which are the building blocks of protein, it directly influences the amino acid composition of protein and thereby nutritional quality of the economic produce. It is considered to be one of the most important nutrient for sunflower however too much of it could decrease the oil content which ultimately decreases the quality of crop so it is essential to ascertain the correct dosage of nitrogen so as to obtain optimum growth without its adversities.

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Conflict of Interest

The authors declare that they don't have any conflict of Interest.

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