African Journal of Agronomy Vol. 2 (6), pp. 177-179, June, 2014. Available online at www.internationalscholarsjournals.org

Full Length Research Paper

The result of nitrogen, sulphur and farmyard manure on growth and yield of sunflower (*Helianthus annuus* L.) under moderate conditions

Gaurav Kaushik, Jadav Vishnu and Ranjan Arslan

College of Agriculture, Faculty of Crop Physiology, Assam Agricultural University, Jorhat, Assam, India.

Accepted 29 May, 2014

An attempt was initiated during two consecutive *kharifs* of 2009 and 2010 at Agronomy Farm of Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir to ascertain the impact of nitrogen (N), sulphur (S) and farmyard manure (FYM) which was taken from farm animals (Bovine) on developmental dynamics and yield of sunflower. Application of N at 80 and 120 kg ha^{-1} at par, significantly increased periodic growth parameters and yield over 40 kg N ha^{-1}. S at 60 kg ha^{-1} showed yield advantage over 30 kg S ha^{-1}. Seed yield with 10 and 20 t FYM ha^{-1} was significantly higher over the control. Availability of N was highest with treatment combination of 120 kg N + 60 kg S + 20 t FYM ha^{-1}. Similarity was observed for available S. Therefore, for sustainably higher yield of sunflower, the nutrient management must centre around 120 kg N + 60 kg S ha^{-1} with 20 t FYM ha^{-1}.

Key words: Seed yield, farmyard manure (FYM), nitrogen (N), oil content, sulphur (S), sunflower.

INTRODUCTION

Sunflower (*Helianthus annuus* L.) the most important oilseed crops of the world because of the adequate concentration of unsaturated fatty acids (900 g kg^{-1}) in its oil (Burton et al., 2004) and occupies second place next to soybean as a source of vegetable edible oil. Sunflower has gained popularity of all the oilseed crops, because of its excellent quality oil due to its richness with high degree polyunsaturated fatty acids, anticholesterol properties, short duration, wide adaptability to soil and climatic conditions, photo and thermo-insensitiveness, drought tolerance and higher oil yield per unit area (Thimmegowda et al., 2007). In India, it is cultivated over an area of about 2.4 million hectares with the production of 1.44 million tones and productivity of 6.08 q ha^{-1} as against 12.71 q ha^{-1} of the world productivity (Anonymous, 2008).

Amongst many factors responsible for its low productivity, the inadequate and imbalanced nutrition of essential nutrients is the most important. Nitrogen (N) affects the seed quality by increasing proteins and decreasing oil concentration (Gudade et al., 2009). Sulphur (S) helps in the synthesis of cystein, methionine, chlorophyll, vitamins (B, biotin and thiamine), metabolism of carbohydrates, especially by its effect on the protolytic enzymes (Najar et al., 2011). For higher productivity and sustainability, integrated use of organic and inorganic sources of nutrients is very important. In view of these, the present investigation was carried out to study the effect of N, S and FYM application on growth and yield of sunflower under temperate conditions.

Corresponding author E-mail: Gaurav16@yahoo.com

Table 1. Effect of nitrogen on growth, yield attributes and yield of sunflower.

Nitrogen levels (kg/ha)	Plant height (cm)	Dry matter (t/ha)	Achenes/ capitulum	Sterility (%)	Test weight (g)	Achene yield (t/ha)	Oil yield (t/ha)
40	106.4	6.15	318.4	6.38	57.6	2.03	0.83
80	112.0	6.89	356.5	6.82	59.9	2.43	0.97
120	115.9	7.20	363.3	8.15	60.0	2.55	1.02
SE (m) ±	1.14	0.103	2.27	0.39	0.46	0.06	0.01
CD (p=0.05)	3.31	0.298	6.56	1.14	1.33	0.18	0.03

MATERIALS AND METHODS

The field experiment was conducted at the Research farm, Division of Agronomy, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir for two consecutive rainy (kharif) seasons of 2009 and 2010 situated between 34°.05 N latitude and 74°.89 E longitude at an altitude of 1587 m. Soil of the experimental site was silty clay loam in texture having 1.4% coarse sand, 18.2% fine sand, 42.4% silt, and 38% clay. The experiment was laid out in 3 × 2 × 3 factorial randomized block design, having 18 treatment combinations which were replicated thrice and compared with the recommended doses. The treatments comprised of three N levels viz. 40, 80, and 120 kg N ha^{-1}, two S levels viz. 30 and 60 kg S ha^{-1} and three FYM treatments viz. 0, 10 and 20 t ha^{-1}.

FYM as per treatment was incorporated in the soil. Phosphorus (P) at 60 kg P_2O_5 ha^{-1} and potassium (K) at 40 kg K_2O ha^{-1} were uniformly applied to each plot as a basal dose during both years of experimentation. Remaining half dose of N was applied in two equal splits one each at 30-35 days after sowing (DAS) and flowering stage. N, P, K and S were applied through urea, di-ammonium phosphate, muriate of potash and calcium (Ca) sulphate dihydrated ($CaSO_4$ $2H_2O$), respectively. The soaked seeds of sunflower variety "Morden" were line sown spaced at 45 cm. Five random plants were selected in each treatment, excluding the border row, for taking observation on plant height. Leaf area index was recorded using canopy analyzer (Accu PAR Model LP-80). For dry matter, representative plant samples in penultimate rows of each plot were dried in shade followed by oven drying at 60 to 65°C to a constant weight. The oil content in seed was determined with Nuclear Magnetic Resonance Spectroscope (Ne Port Analyser Model MK III A) employing non-destructive method of oil estimation in seed. The data obtained in respect of observation were statistically analyzed (Cochran and Cox, 1963). The significance of "F" and "t" was tested at 5% level of significance.

RESULTS AND DISCUSSION

Effect of nitrogen on growth and yield

From the Table 1, it is evident that, growth and yield components of sunflower increased with increasing N application up to 120 kg ha^{-1} as against 40 kg N ha^{-1}. The findings are attributed to N effects on cell elongation, as well as N being the principal constituent of proteins, enzymes, hormones, vitamins, chlorophyll. N also accelerates the meristematic activity of plant which leads to progressive increases in internode length, protein synthesis and photosynthetic area leading to improved leaf area index and dry matter production. The results corroborate the findings of (Awasthi et al., 2011). The sterility percentage in relation to achene development increased significantly with each added increment of N. This could be attributed to higher number of achenes capitulum^{-1} at higher nitrogen levels thereby resulting in increased competition for photosynthates to translocate in the economic part. The data also indicate that pooled seed yield enhanced by 21.21%with dose of 120 kg N ha^{-1} over 40 kg N ha^{-1}. The findings are in conformity with those of Sarkar and Mallick (2009) who obtained significantly higher seed yield in sunflower fertilized with 120 kg N ha^{-1} with yield superiority of 20% as against application of 60 kg N ha^{-1}.

Effect of sulphur on growth and yield

The data on growth parameters from Table 2 inferred the increased plant height at higher S levels during both years of study. This logistics might be increased metabolic processes in the plant and increased meristamatic activities causing more apical growth. Similar results of significance in plant height with the application of 60 kg S ha^{-1} as against 0 kg S ha^{-1} were those of Hussain and Thomas (2010). Leaf area index, a vital photosynthetic character was found to increase with S application at 60 kg S ha^{-1}over 30 kg S ha^{-1}. S being a constituent of succinyl Co-A involved in chlorophyll in leaves and their activation at cellular level by promoting photosynthesis which seemed to have promoted vegetative growth in terms of leaf area index. Similar results were reported by Shekhawat and Sivay (2008). Application of 60 kg S ha^{-1} significantly increased the test weight over 30 kg S ha^{-1}.

Synthesis of proteins at higher S level may have resulted in proper partitioning of photosynthates from source to sink resulting in the improvement in yield contributing characters like 1000 seed weight and filled achenes capitulum^{-1}. These results corroborate the findings of Ravi et al. (2008) who reported significantly higher test weight and increased number of capsules per plant with the application of 30 kg S ha^{-1} over no S addition in safflower. Application of 60 kg S ha^{-1} increased the seed yield by 8.85% over 30 kg S ha^{-1}. These results might be due to higher yield contributing

Table 2. Effect of sulphur on growth, yield attributes and yield of sunflower.

Sulphur levels (kg/ha)	Plant height (cm)	Dry matter (t/ha)	Achenes/ capitulum	Sterility percent	Test weight (g)	Achene yield (t/ha)	Oil yield (t/ha)
30	110.24	6.59	336.4	6.81	58.17	2.24	0.88
60	112.70	7.40	355.7	7.48	60.06	2.42	1.00
SE (m) ±	0.93	0.084	1.85	0.32	0.37	0.06	0.009
CD (p=0.05)	2.70	0.243	5.35	NS	1.08	0.17	0.025

NS: Non-significant.

Table 3. Effect of farmyard manure on growth, yield attributes and yield of sunflower.

FYM levels (t/ha)	Plant height (cm)	Dry matter (t/ha)	Achenes/ capitulum	Sterility percent	Test weight (g)	Achene yield (t/ha)	Oil yield (t/ha)
0	108.57	6.31	321.4	6.06	57.71	2.16	0.86
10	112.50	6.91	352.8	6.53	59.73	2.35	0.95
20	113.38	7.01	364.0	8.83	60.08	2.51	1.02
SE (m) ±	1.14	0.103	2.27	0.39	0.46	0.63	0.011
CD (p = 0.05)	3.31	0.298	6.56	1.14	1.33	0.18	0.031

characters that are directly responsible for higher seed yield. The results are in association with those of Poomurugesan and Poonkodi (2008) who recorded maximum achene yield of 2162.1 kg ha^{-1} with the treatment of 60 kg S ha^{-1} and minimum with 0 kg S ha^{-1} treated plots. S at 60 kg S ha^{-1} significantly increased the oil content and oil yield over 30 kg S ha^{-1}. S being a constituent of acetyl Co-A, is converted into maloyl Co-A in fatty acid synthesis and for this conversion an enzyme, thiokinase is involved. Rani et al. (2009) reported that, increase in oil yield of sunflower with the application of S at 60 kg ha^{-1} was up to the tune of 23% as against control.

Effect of FYM on growth and yield

As per the results in Table 3, the farmyard manure (FYM) application significantly increased the growth and yield parameters of sunflower over the control. Leaf area index also showed increasing trend with the addition of FYM. Apart from providing both macro and micronutrients, FYM increases the availability of added inorganic nutrients resulting in the positive effect on the number of leaves plant^{-1}, thereby increased photosynthetic surface improved the leaf area index. Byrareddy et al., (2008) inferred that FYM application at 8 tonnes ha^{-1} recorded taller plants with higher number of leaves per plant as against no FYM addition. Dry matter production a vital growth character was found to increase significantly with FYM application at 10 or 20 t ha^{-1}over control though 10 and 20 t ha^{-1} was similar.

Abdel-Sabour et al. (1999) found that, dry matter of leaves, stem, flowers and economic part significantly increased by the application of organic manure due to the fact that, completely decomposed organic manure may have released the nutrients in available form. Besides, improvement in soil physical, chemical, and biological properties as well as nutrition status due to addition of organic manure may have contributed to the higher dry matter yield. From Table 3, it is evident that various yield contributing characters viz., number of filled achenes capitulum, 1000 seed weight recorded significant improvement with application of 10 and 20 t FYM ha^{-1}, being statistically similar over no FYM application.

Increase in yield contributing characters might be due to the fact that, FYM is a store house of several macro and micronutrients which are released during the process of mineralization. Thus, FYM might have stimulated the activity of microorganisms that make the plant nutrients readily available to the crop. Moreover, synthesis of phytin (Isoinsitolhexa phosphate) which is a salt of Ca, magnesium (Mg), and P (salts of Ca, Mg are present in cow urine) may have increased the seed weight. These findings are in accordance with those of Manjunatha et al., (2009) who observed improved values of yield parameters with incorporation of FYM at 7.5 t ha^{1} + 100% recommended dose of fertilizer compared to control.

Seed yield of sunflower enhances during both years of 2009 and 2010 as well as pooled yield over two years than no FYM application.

The pooled data showed that, 20 and 10 t FYM increased the seed yield by 15.46 and 9.36 % over no FYM application respectively. FYM seems to act directly in increasing crop yields either by acceleration of respiratory process by increasing cell permeability by hormone growth action or by combination of all the processes viz., release of nutrients, increasing availability of nutrients and improving soil physical, chemical and biological properties. The beneficial effect of FYM on sunflower was well documented by Nanjundappa et al.,(2001) who recorded the higher achene yield in sunflower with the application of recommended dose of fertilizers (62.5:75:62.5 kg NPK ha^{-1}) along with 10 t FYM ha^{-1}. The oil content as well as oil yield recorded significant increase with increase in FYM application over no FYM application. However, 10 and 20 t FYM ha^{-1} levels were statistically at par. Similarity in results were those of Muniret et al.,(2007) who reported highest oil content (43.7%) from FYM treated plots as against the control ones.

Conclusion

Based on the foregoing results, it can be concluded that, highest values of sunflower yield, yield quality and its components as well as nutrient uptake and available nutrients in the soil were obtained with the plants supplied with 120 kg N + 60 kg S ha^{-1} with 20 t FYM ha^{-1} However, for maintaining soil health 80 kg N + 60 kg S + 10 t FYM ha^{-1} nutrient dose could be used but such nutrient studies require more critical testing at multi locations over a long period.

REFERENCES

Abdel-Sabour MF, Abo El-Seoud MA, Rizk M (1999). Physiological and chemical response of sunflower to previous organic waste composts application to sandy soils. Egypt. J. Soil Sci. 39: 407-420.

Anonymous (2008). Agricultural statistics at a glance. 2008. Directorate of economics and statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, GOI, New Delhi.

Awasthi UD, Dubey SD, Shripal (2011). Effect of nitrogen and moisture conservation practices on yield, uptake, water use efficiency and quality of linseed *(Linum usitatissimum).* Indian J. Agric. Sci. 81 (4):383-385.

Burton JW, Miller JF, Vick BA, Scarth R, Holbrook CC (2004). Altering fatty acid composition in oilseed crops. Adv. Agron. 84:273-306.

Byrareddy K, Uppar DS, Vyakaranahal BS, Hiremath SM, Hunje R, Nadaf HI (2008). Effect of Integrated Nutrient Management on Sunflower Hybrid (KBSH-I) Seed Production. Karnataka J. Agric. Sci. 21(2):171-175.

Cochran GC, Cox MM (1963). Experimental designs. Asia Publishing House, Bombay, pp. 293-316.

Gudade BA, Thakur MR, Ulemale RB, Imade SR, Bodhade MS (2009). Nutrient uptake, soil nutrient status and quality of new sunflower varieties as influenced by fertilizer levels. J. Soils Crops 19(2):355-359.

Hussain SS, Thomas T (2010). Effect of nitrogen and sulphur on yield, mineral accumulation and protein content of sunflower (*Helianthus annuus* L.) in inceptisols. Res. J. Agric. Sci. 1(2):89-92.

Manjunatha GS, Upperi SN, Pujari BT, Yeledahalli NA, Kuligod VB (2009). Effect of farmyard manure treated with jeevamrutha on yield attributes, yield and economics of sunflower *(Helianthus annuus* L.*).* Karnataka J. Agric. Sci. 22(1):198-199.

Najar GR, Singh SR, Akthar F, Hakeem SA (2011). Influence of sulphur levels on yield, uptake and quality of soyabean *(Glycine max)* under temperate conditions of Kashmir valley. Indian J. Agric. Sci. 81(4):340-343.

Nanjundappa G, Shivaraj B, Janarjuna S, Sridharan S (2001). Effect of organic and inorganic source of nutrients applied alone or in combination on growth and yield of sunflower (*Helianthus annuus* L.) in Alfisols. Helia. 24:115-120.

Poomurugesan AV, Poonkodi P (2008). Effect of Sources and Levels of Sulphur on Growth and Yield Performances of Sunflower *(Helianthus annuus).* Mysore J. Agric. Sci. 42(1):147-153.

Rani UK, Sharma KL, Nagasri K, Srinivas K, Murthy TV, Shankar GR, Korwar GR, Sankar GK, Madhavi M, Grace JK (2009). Response of sunflower to sources and levels of sulphur under rainfed semi-arid tropical conditions. Commun. S. Sci. Pl. Ana. 40:2926-44.

Ravi S, Channal HT, Hebsur NS, Patil BN, Dharmatti PR (2008). Effect of sulphur, zinc and iron nutrition on growth, yield, nutrient uptake and quality of safflower *(Carthamus tinctorius L.)*. Karnataka J. Agric. Sci. 21 (3):382-385.

Sarkar RK, Mallick RB (2009). Effect of nitrogen, sulphur and foliar spray of nitrate salts on performance of spring sunflower *(Helianthus annuus L.).* Indian J. Agric. Sci. 79(12):986-990.

Thimmegowda MN, Nanjapa HV, Ramachandrappa BK (2007). Effect of soil solarization and farmyard manure application on weed control and productivity of sunflower *(Helianthus annus)*-bell pepper *(Capsicum annum)* sequence. Indian J. Agron. 52(3):204-207.