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EFFECT OF DIFFERENT PLANTING GEOMETRY AND SULPHUR FERTILIZATION ON GROWTH AND YIELD OF SUNFLOWER IN SUNFLOWER + GREENGRAM INTERCROPPING SYSTEM

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ABSTRACT

A field experiment was carried out during Mar-May, 2019 at the Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalai nagar-608002, to study the effect of different planting geometry and sulphur levels in sunflower + greengram intercropping system on the growth and yield attributes and yield of sunflower. The experiment consisted of twenty treatments and were laid out in factorial randomized block design with two replications. The treatment consisted of Factor A(different plant geometry levels): M_1 - sole sunflower (60 x 30 cm),M_2 - sunflower (60 x 30 cm) + 1 row of greengram, M_3 - sunflower (90 x 30 cm) + 2 rows of greengram, M_4 - sunflower (120 x 30 cm) + 3 rows of greengram, M_5 -sole greengram and Factor B (sulphur levels): S_0 - 0 kg S ha^{-1}, S_1 - 20kgS ha^{-1},S_2 - 40kg S ha^{-1} and S_3- 60kg S ha^{-1}.The results revealedthat growth, yield attributes and yieldwere significantly influenced by different plant geometry and various sulphur levels. Among the different planting geometry levels tried, sole sunflower (60 x 30 cm) (M_1) significantly recorded maximum growth and yield attributes and yield of sunflower. With regard to various sulphur levels tried, application of sulphur at 40 kg ha^{-1} (S_2) significantly recorded maximum growth and yield attributes and yield of sunflower. Interaction between planting geometry and sulphur levels were significant.Among the treatment combinations tried, sole cropping of sunflower (60 x 30 cm) along with application of S at40 kg ha^{-1} (M_1S_2)had a spectacular effect on growth and yield attributes, ultimately leading to maximum seed yield(2152 kg ha^{-1}). The minimum growth attributes were recorded in sunflower(120 x 30 cm) intercropped with three rows of greengram along with application ofSat 0 kg ha^{-1} (M_4S_0).

Keywords: sunflower, planting geometry,intercropping,sulphur, growth, yield.

INTRODUCTION

Oilseed plays a vital role in Indian agriculture as food for human and concentrate for animals. Oilindustry is an important determinant of agricultural economy in India. Oilseed crops occupied 14 per cent of the gross cropped area and is the second largest agricultural commodity after cereals (Kumar *et al*., 2016).Among the oilseed crops, sunflower (*Helianthus annuus* L.) is an all-season crop. Sunflower has gained popularity in the recent past because of its excellent quality oil due to richness with high degree poly unsaturated fatty acids, anti cholesterol 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).Sunflower seed is highly nutritious containing 14-19per cent protein and 40-45 per cent oil associated with very high calorific value and 30-35 per cent carbohydrates. Plant geometry determines the distribution pattern of plants in a field. It affects evaporation, water use efficiency of the crop and weed intensity competition. Proper spacing of plants in a particular area makes plant canopy more effective in intercepting the radiant energy and shading effect on weeds resulted higher growth and yield (Saleem *et al*., 2008). In modern agriculture, intercropping is considered to be an effective and most potential way of increasing crop production per unit area.Khan and Akmal (2014) documentedthatintercropping of pulsesis the one way of increase overall productivity and also claimed that intercropping of sunflower is more beneficial than sole cropping of sunflower. Balance supply of macro and micro nutrients enhanced the oilseed production, among them sulphur plays a multiple role in providing nutrition to oilseed crops. Sulphur is the fourth most important nutrient and it is best known for its role in the synthesis of proteins, oils, vitaminsand flavoured compounds in plants. Sulphur is also involved in the formation of chlorophyll, glucosides and glucosinolates (mustard oils), activation of enzymes and sulphydryl linkages that are the source of pungency in onion, oils, etc. (Jamal *et al*., 2010). Thus, adequate sulphur is so crucial for oil seed crops. Sulphur deficiency in sunflower is detrimental to seed yield and quality. Oil yield is a function of oil content and grain yield, both the attributes increased with increasing the levels of sulphur resulting in a significant increase in oil yield (Kumar *et al*., 2011).

MATERIALS AND METHODS

The field investigation was carried out during March-May, 2019 at Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalai Nagar. The soil of experimental field was clay loam in texture. The soil was low in available nitrogen, medium in available phosphorous, high in available potassium and low inavailable sulphur. The sunflower cultivar TNAU sunflower hybrid CO 2 was chosen for the study. The intercrop greengram (ADT-3) was chosen for the study. The experiment consisted of twenty treatments and were laid out in factorial randomized block design with two replications. The treatment consisted of Factor A(different plant geometry levels): M_1 - sole sunflower (60 x 30 cm),M_2 -sunflower (60 x 30 cm) + 1 row of greengram, M_3 -sunflower (90 x 30 cm) + 2 rows of greengram, M_4 -sunflower (120 x 30 cm) + 3 rows of greengram, M_5 -sole greengram and Factor B(sulphur levels): S_0 - 0 kg S ha^{-1}, S_1 - 20kg S ha^{-1}, S_2- 40kg S ha^{-1} and S_3- 60kg S ha^{-1}through gypsum. Recommended dose of 60:90:60 kg of N,P and K ha^{-1} was applied in the form of urea, DAPand MOP respectively. Half the dose of N and entiredose of P and K were applied basally.The remainingquantity of N was applied at 30 DAS.The biometric observations were recorded at critical stages and at harvest. The estimated data were analysed as per the procedure outlined by Gomez and Gomez (1994). The critical difference was worked out at five per cent probability level for significant result.

RESULTS AND DISCUSSION

Growth attributes (Table 1)

Different planting geometry levels significantly influenced the growth attributes of sunflower.The sole sunflower which is grown with a spacing of 60 x 30 cm (M_1) recorded maximum values for plant height, LAI, DMP, CGR, RGR, chlorophyll content and early days to fifty per cent flowering. This might be due to an uninterrupted availability of various resources *viz.,* sunlight, soil moisture and nutrients for sole sunflower have helped the crop to utilize the resources to a greater extent resulting in enhanced values of all growth parameters. Leaf area index (LAI) had crucial significance in increasing the crop yield. More number of plants m^{-2} and higher leaf numbers plants^{-1}might be the possible reason for maximum leaf area index (Iqbal *et al.,* 2007).Similar findings were noticed by Baradan (2007). Application of different levels of sulphur was foundto influence the growth attributes of sunflower *viz.,* plant height, LAI,DMP, CGR, RGR, chlorophyll content and early days to fiftypercent flowering. The growth attributes weresignificantly enhanced by application of sulphur at 40 kg ha^{-1} (S_2)This response was due to deficiency of sulphur inexperimental soil. Addition of sulphur nutrition enhanced the cell division, cell elongation and expansion and chlorophyll synthesis. It was also important in the activity of meristematic tissues and development of shoots(Ravi *et al.,* 2010).Thus, adequate supply of sulphur will be expected that plants grow taller with a greater number of leaves having bigger size and higher chlorophyll content.Since sulphur is constituent of succinyl CO A, which is precursor of biosynthesis of chlorophyll. These results were in agreement with the findings of Vaiyapuri *et al.,* (2004).

The interaction effect between plant geometry and sulphur levels were found to be significant on growth attributes at all stages of crop growth. The higher growth attributes *viz.,* plant height, LAI, DMP, CGR, RGR, chlorophyll content and early fifty per cent flowering under the treatment combination of sole sunflower with application of 40 kg S ha^{-1}(M_1S_2), which produced higher growth attributes due to increased utilization of carbohydrate for synthesis of protein and more availability of photosynthesizing area

Table 1: Effect of different planting geometry and sulphur fertilization on growth attributesof sunflower

Treatments	Plant height (cm) at harvest	LAI at flowering stage	DMP (kg ha^{-1}) (at harvest)	CGR at floweringstage (g $m^{-2}day^{-1}$)	RGR at flowering stage (g m^{-2} day^{-1})	Chlorophyll content (mg g^{-1})	Days to 50 % flowering
Plant Geometry							
M_1	152.0	4.53	4878	5.22	0.073	26.03	51.75
M_2	148.4	4.45	4667	5.06	0.068	25.27	52.78
M_3	144.41	4.33	4433	3.16	0.063	24.08	53.97
M_4	139.9	4.16	4158	2.25	0.057	23.00	54.99
S.Ed	1.59	0.04	18.85	0.06	0.002	0.15	0.29
CD(P=0.05)	3.26	0.07	38.06	0.11	0.004	0.28	0.59
Sulphur							
S_0	134.9	3.96	4110	3.54	0.059	20.93	56.05
S_1	144.3	4.19	4422	3.92	0.063	24.39	53.86
S_2	155.6	4.72	4895	4.18	0.072	27.60	51.30
S_3	150.0	4.61	4709	4.05	0.067	25.47	52.28
S.Ed	1.63	0.04	18.70	0.06	0.003	0.14	0.29
CD(P=0.05)	3.34	0.08	38.16	0.11	0.006	0.30	0.59

Table 2: Effect of different planting geometry and Sulphur fertilization on yield attributes and yield of sunflower

Treatments	Head diameter (cm)	Number of seeds head^{-1}	Number of filled seeds head^{-1}	Seed filling percent	100 seed weight (g)	Seed yield (kg ha^{-1})	Stalk yield (kg ha^{-1})
Plant Geometry							
M_1	17.73	860	711	82.67	5.68	2018	4038
M_2	16.81	814	659	80.95	5.61	1912	3945
M_3	15.74	775	611	78.83	5.54	1785	3834
M_4	14.42	726	557	76.72	5.47	1646	3696
S.Ed	0.11	8.23	6.56	0.14	0.03	26.62	16.51
CD(P=0.05)	0.24	16.56	13.19	0.30	NS	53.52	33.20
Sulphur							
S_0	14.26	694	522	75.21	5.37	1648	3642
S_1	15.65	762	600	78.74	5.54	1789	3838
S_2	17.90	876	729	83.21	5.75	2016	4055
S_3	16.88	843	687	81.49	5.64	1908	3978
S.Ed	0.12	8.09	6.57	0.15	0.04	26.94	16.54
CD(P=0.05)	0.26	16.27	13.21	0.32	0.08	54.16	33.25

and physiological capacity to translocate them to the organ of vegetative growth. Similar results were earlier reported byAnas *et al.,* (2017).

Yield attributes and yield (Table 2)

Among the different planting geometry levels, the sole sunflower grown with a spacing of60 x 30 cm (M_1) significantly registered maximum yield attributes *viz.,*head diameter, total number of seeds head^{-1}, number of filled seeds head^{-1}, percentage of filled seeds and maximum seed yield and stalk yield. However, the test weight is not influenced significantly due to plant geometry levels.The improvement of growth attributes leads to higher yield attributes and also absence of competition from intercrop resulting in higher nutrient uptake, higher photosynthetic assimilates production and effective portioning from source to sink (Saleem *et al*., 2008). The results were in agreement with the findings of Sarma *et al*., (2016).

Application of sulphur at 40 kg ha^{-1}(S_2) significantly increased yield attributing characters *viz.,* head diameter, total number of seeds head^{-1}, number of filled seeds head^{-1}, percentage of filled seeds, test weight, seed yield and stalk yield over other levels of sulphur. This significant and positive influence of sulphur on head diameter and number of filled seeds per head was due to improved growth through increased nutrient assimilation which in turn accelerated the crop to put forth larger heads and filled seed.Significant increase in total number of seeds head^{-1} and number of filled seedshead^{-1} due to sulphur through gypsum could be attributed to improve the availability of most of the nutrients and created more favourable soil environment which helped the plant to uptake large quantity of nutrients resulted in increased seed and stalk yield (Thorat *et al*., 2007). This is also due to more accumulation of amino acids and amide substances and their translocation to the reproductive organs which influenced growth and yield due to application of sulphur. Similar findings were earlier reported by Kumar *et al*., (2011).

The interaction effect between plant geometry and sulphur levels were found to be significant on yield attributes and yield of sunflower. The highervalues on yield characteristics *viz.,* head diameter, total number of seeds head^{-1}, number of filled seeds head^{-1}, percentage of filled seeds, test weight and also higher seed yield and stalk yieldwere observed under the treatment combination of sole sunflower (60 x 30 cm) with application of 40 kgS ha^{-1} (M_1S_2) due to higher yield characteristics and non-competition effects in using the available resource and optimum supply of sulphur. The minimum values for yield attributes, seed yield and stalk yield were recorded under the treatment combination of sunflower(120 x 30cm) intercropped with three rows of green gram along with application of S at0 kg ha^{-1} (M_4S_0)which could be due to inadequate availabilityof nutrients (Anas *et al.,* 2017). The similar trend of result was noticed by Singh *et al*., (2013).

REFERENCES

Anas, M., A. Jabbar, M. A. Sarwar, R. Ullah, M. K. Abuzar, I. Ahmad and S. Latif. 2017. Intercropping sunflower with mungbean for improved productivity and net economic return under irrigated conditions. *Pak. J. Agric. Res.,* 30(4): 338-345.

Baradan, G. 2007. Studies on legume intercropping and nutrient management in sunflower. M.Sc.,(Ag.) Thesis. Annamalai Univ., Annamalai Nagar, Tamil Nadu, India.

Gomez, K. A. and A. A. Gomez. 1994. Statistical produce for Agricultural research, 11thedn. John Wiley and Sons., New York, p.68.

Iqbal, J., M. A. Malik, B. Hussain and M. A. Munir. 2007. Performance of autumn planted sunflower (*Hilianthus annuus* L.) hybrids under different planting patterns. *Pak. J. Agri. Sci., 44*(4): 587-591.

Jamal, A., M. Y. Sun and M. Z. Abdin. 2010. Sulphur - a general overview and interaction with nitrogen. *Aus. J. Crop Sci.,* 4(7): 523-529.

Khan, M. A. and M. Akmal. 2014. Sole and intercropping sunflower-mungbean for spring cultivation in Peshawar. *Pure and App. Bio*., 3(4): 121-131.

Kumar, N., V. Singh, and A. Choudhary. 2016. Effect of different levels of phosphorus and sulphur on growth and yield of sunflower (*Helianthus annuus* L.). *Res. Environ. Life Sci.,* 9(9): 1150-1152.

Kumar, S., S. K. Tewari and S. S. Singh. 2011. Effect of sources and levels of sulphur and spacing on the growth, yield and quality of spring sunflower (*Helianths annuus* L.). *Ind. J. Agron*., 56(3): 242-246.

Ravi, S., H. T. Channal and S. Kumar. 2010. Response of sulphur and micronutrients (Zn and Fe) on yield and available nutrients of safflower (*Carthamustinctorius*L.). *Asian J. Soil Sci.*, 5(2): 402-405.

Saleem, M. F., M. A. Malik, M. A. Cheema and M. A. Wahid. 2008. Yield and quality response of autumn-planted sunflower (*Helianthus annuusL.*) to sowing dates and planting patterns. *Can. J. Plant. Sci.*, 88(1): 101-109.

Sarma, D., P. Saikia, M. Bhattacharjee, M. Hazarika, R. Rajbonshi, R. K.Goswami, P. K. Sarma, M. K. Sarma and P. Neog. 2016. Effect of intercropping greengram and blackgram in sesame for augmenting the productivity and rain water use efficiancy under rainfed upland condition. *Ind. J. Agric. Res. & Dev*., 31(1): 51-55.

Singh, D. N., J. S. Bohra and J. K. Singh. 2013. Influence of N, P, K and S on growth, yield and quality of irrigated linseed (*Linumusitatissimum). Ind. J. Agric. Sci*., 83(4): 456-458.

Thimmegowda, M. N., H. V. Nanjapa and B. K. Ramachandrappa. 2007. Effect of soil solarization and farmyard manure application on weed control and productivity of sunflower (*Helianthus annus*L.), bell pepper (*Capsicum annum*) sequence. *Ind. J. Agron*., 52(3): 204-207.

Thorat, D. G., A. Hamid, M. D. Giri, M. Sajid and J. R. Katore. 2007. Effect of irrigation, phosphorus and sulphur on growth and yield attributes of *rabi* sunflower. Ann. Plant Phys., 21(1): 71-74.

Vaiyapuri, V., C. Ravikumar, M. V. Sriramachandrasekharan and M. Ravichandran. 2004. Effect of sulphur on groundnut yield and quality nutrient uptake of sunflower. Inter. *J. Acad.,* 8(3): 371-376.