Plant Archives Vol. 19, Supplement 1, 2019 pp. 753-756 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

INFLUENCE OF INTEGRATED NUTRIENT MANAGEMENT PRACTICES ON NUTRIENT UPTAKE AND YIELD OF IRRIGATED SUNFLOWER

***A.Balasubramanian[1], I.Manikandan[1], R.Gobi[1], N. Senthil kumar[2] and P.Stalin[1]**
[1]Department of Agronomy, [2]Department of Soil Science and Agricultural Chemistry,
Faculty of Agriculture, Annamalai University, Annamalainagar – 608002 (T.N.), India.
*Email: drabalu1975@gmail.com

Abstract

Field experiment was conducted at the Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalainagar to evaluate the influence of integrated nutrient management practices on nutrient uptake and yield of irrigated sunflower. The experiment was laid out in randomized block design with three replications. The treatments consists of T_1 - Control, T_2 - Recommended dose of fertilizer (RDF – 50:60:40 kg NPK ha^{-1}), T_3 – RDF + FYM @ 12.5 t ha^{-1}, T_4 – RDF + $ZnSO_4$ @ 25 kg ha^{-1}, T_5– RDF + *Azospirillum* seed treatment @ 600 g ha^{-1}, T_6 - RDF + *Azospirillum* soil application @ 2 kg ha^{-1}, T_7–T_3 + $ZnSO_4$ @ 25 kg ha^{-1}, T_8–T_3 + *Azospirillum* seed treatment @ 600 g ha^{-1}, T_9–T_3 + Azospirillum seed treatment @ 600 g ha^{-1}, T_{10}–T_3 + $ZnSO_4$ @ 25 kg ha^{-1} + *Azospirillum* seed treatment @ 600 g ha^{-1}, T_{11}-T_3 + $ZnSO_4$ @ 25 kg ha^{-1} + *Azospirillum* soil application @ 2 kg ha^{-1}. Dry matter production, nutrient uptake, number of filled seeds $capitulum^{-1}$, seed yield and stalk yield were recorded. Net return and return $rupee^{-1}$ invested were also calculated. Among the different treatments, application of RDF + FYM @ 12.5 t ha^{-1} + $ZnSO_4$ @ 25 kg ha^{-1} + *Azospirillum* soil application @ 2 kg ha^{-1} (T_{11}) recorded higher values of dry matter production, nutrient uptake, filled seeds $capitulum^{-1}$, seed yield and stalk yield. This treatment was statistically on par with application of RDF + FYM @ 12.5 t ha^{-1} + $ZnSO_4$ @ 25 kg ha^{-1} + *Azospirillum* seed treatment @ 600 g ha^{-1} (T_{10}). Application of RDF + FYM @ 12.5 t ha^{-1} + $ZnSO_4$ @ 25 kg ha^{-1} + *Azospirillum* soil application @ 2 kg ha^{-1} (T_{11}) recorded higher net return and return $rupee^{-1}$ invested.

Keywords: INM, FYM, *Azospirillum*, $ZnSO_4$, Nutrient uptake, Sunflower.

Introduction

Sunflower (*Helianthus annuus* L.) is one of the most popular members of the family Asteraceae and is one of the world's most important sources of vegetable oil. The native of the sunflower is reported to be the Southern parts of United States of America and Mexico. Sunflower ranks third, next to groundnut and soybean in the total production of oilseeds in the world. Sunflower is grown on an area of 23.70 million hectares with an annual production and productivity of 31.33 million tones and 1322 kg ha^{-1}, respectively in the world. Though, sunflower crop has yield potential of around 2.3 to 2.5 tonnes per hectare under favourable conditions, mean productivity level in India is only 0.6 tonnes per hectare. In India it is grown on 1.48 million hectares with an annual production of 1.85 million tones and productivity of 576 kg ha^{-1}. Sunflower crop has been well accepted by the farming community because of its desirable attributes such as short duration, photoperiod insensitive, drought tolerance, lower seed rate, high seed multiplication ratio, high quality of edible oil and high content of linolenic acid, which is a poly-unsaturated fatty acid.

Micronutrients have been reported to play a major role in increasing seed setting percentage in sunflower owing to their influence on growth and yield components (Krishna Murthy *et al.,* 2011). However, the limitation on the realization of optimum yield from this valuable oil seed is poor germination of seeds and improper filling of seeds. These physiological disorders of sunflower can be set right through the balanced supply of nutrients as one of means by adopting the integrated nutrient management practices for the crop. Integrated nutrient management is gaining momentum in view now because of its beneficial effect on soil nutrients, soil microbes and crops. There is a strong need to adopt integrated nutrient supply system with judicious combination of inorganic fertilizers, organic manure, micronutrients and biofertilizers to improve the soil health and sunflower productivity. In this context, the integrated nutrient management holds great promise in meeting the growing nutrient demands of intensive agriculture and maintaining the crop productivity.

Materials and Methods

Field experiment was conducted at the Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalainagar to evaluate the influence of integrated nutrient management practices in irrigated sunflower. The experimental field is situated at 11° 24' N latitude and 79° 44' E longitude at an altitude of +5.79 m above mean sea level. The climate of Annamalainagar is moderately warm with hot summer months. Soil is low in available nitrogen, medium in available phosphorus and high in available potassium. The experiment was laid out in randomized block design with three replications. The treatments consists of T_1 - Control, T_2 - Recommended dose of fertilizer (RDF – 50:60:40 kg NPK ha^{-1}), T_3 – RDF + FYM @ 12.5 t ha^{-1}, T_4 – RDF + $ZnSO_4$ @ 25 kg ha^{-1}, T_5–RDF + *Azospirillum* seed treatment @ 600 g ha^{-1}, T_6 - RDF + *Azospirillum* soil application @ 2 kg ha^{-1}, T_7–T_3 + $ZnSO_4$ @ 25 kg ha^{-1}, T_8–T_3 + *Azospirillum* seed treatment @ 600 g ha^{-1}, T_9–T_3 + *Azospirillum* seed treatment @ 600 g ha^{-1}, T_{10}–T_3 + $ZnSO_4$ @ 25 kg ha^{-1} + *Azospirillum* seed treatment @ 600 g ha^{-1}, T_{11}-T_3 + $ZnSO_4$ @ 25 kg ha^{-1} + *Azospirillum* soil application @ 2 kg ha^{-1}. The inorganic nutrients NPK were supplied in the form of urea, single super phosphate and muriate of potash, respectively. The biometric observation like dry matter production, nutrient uptake, number of filled seeds $capitulum^{-1}$, seed yield and stalk yield were recorded. The plant samples were chopped and powdered by using a Willey mill and analysed for N, P and K contents. Net return and return $rupee^{-1}$ invested were also calculated. The data presented was subjected to statistical analysis following the methods suggested by Panse and Sukhatme (1978).

Results and Discussion

Integration of nutrient management practices favouably influenced the dry matter production and nutrient uptake in sunflower (Table. 1). Application of RDF + FYM @ 12.5 t ha^{-1} + $ZnSO_4$ @ 25 kg ha^{-1} + *Azospirillum* soil application @ 2 kg ha^{-1} (T_{11}) recorded higher dry matter production (4720 kg ha^{-1}) at harvest. This was statistically on par with RDF + FYM @ 12.5 t ha^{-1} + $ZnSO_4$ @ 25 kg ha^{-1} + *Azospirillum* seed treatment @ 600 g ha^{-1} (T_{10}). This may be due to the higher uptake of nutrients. Nitrogen is a major constituent of chlorophyll and proteins and adequate supply through fertilizer and organic manure encouraged the photosynthesis. This resulted in an increased total dry matter accumulation. Potassium activates many enzymes in protein and carbohydrate metabolism which significantly enhanced the dry matter accumulation. Similar findings have been reported in sunflower by Shanmugasundaram and Savithri (2005).

With regard to nitrogen uptake by sunflower the maximum was attained by the treatment, the application of RDF + FYM @ 12.5 t ha^{-1} + $ZnSO_4$ @ 25 hg ha^{-1} + *Azospirillum* soil application @ 2 kg ha^{-1} (T_{11}) which 63.65 kg ha^{-1} and this was statistically comparable with RDF + FYM @ 12.5 t ha^{-1} + $ZnSO_4$ @ 25 kg ha^{-1} + *Azospirillum* seed treatment @ 600 g ha^{-1} (T_{10}). The same trend was followed for both P uptake (14.46 kg ha^{-1}) and K uptake (67.58 kg ha^{-1}). Application of NPK and *Azospirillum* might have improved the soil environment resulting in better adsoption of water and nutrients in sunflower. Similar findings were reported by Jagdev Singh and Singh (2000). Increased potassium uptake may be attributed to the release of potassium by biofertilizers from the exchangeable sites and made available to the sunflower plants either by organic or inorganic sources. This result was in consonance with the findings of Rupapunithavathy (2005).

Number of filled seeds $capitulum^{-1}$, seed yield, stalk yield and economics are presented in table 2. Application of RDF + FYM @ 12.5 t ha^{-1} + $ZnSO_4$ @ 25 kg ha^{-1} + *Azospirillum* soil application @ 2 kg ha^{-1} (T_{11}) recorded higher mean number of filled seeds $capitulum^{-1}$ (930.0), seed yield (1953 kg ha^{-1}) and stalk yield (4235.3 kg ha^{-1}). This was statistically on par with RDF + FYM @ 12.5 t ha^{-1} + $ZnSO_4$ @ 25 kg ha^{-1} + *Azospirillum* seed treatment @ 600 g ha^{-1} (T_{10}). This could be due to synergistic and cumulative effect of the integration of inorganic nutrients and biofertilizers on sunflower. The increased dry matter production, higher nutrient uptake and translocation of photosynthates from source to sink might be contributed to greater number of seeds $capitulum^{-1}$. This may be due to the combined effect of $ZnSO_4$ and *Azospirillum* along with readily available chemical fertilizers. Many workers earlier reported the beneficial advantage of chemical fertilizers and $ZnSO_4$ in augmenting the yield components of sunflower (Venkatakrishnan and Balasubramanian, 1996). The treatment control (T_1) registered lower values of growth and yield components and yield.

Higher crop productivity resulted in better economic parameters like net return and return $rupee^{-1}$ invested. Among the treatments, application of RDF + FYM @ 12.5 t ha^{-1} + $ZnSO_4$ @ 25 kg ha^{-1} + *Azospirillum* soil application @ 2 kg ha^{-1} (T_{11}) recorded higher net return of Rs. 45537 ha^{-1} and return per rupee invested of Rs. 3.16. This could be attributed the fact that, the treatments involving combined application of RDF with FYM, $ZnSO_4$ and *Azospirillum* produced higher seed and stalk yield. These results evidently indicated that integration of inorganic fertilizer with organic manure, $ZnSO_4$ and biofertilizer is necessary to augment higher yields than recommended dose of fertilizer alone.

Conclusion

Based on the result of the experiment, it was concluded that application of RDF + FYM @ 12.5 t ha^{-1} + $ZnSO_4$ @ 25 kg ha^{-1} + Azospirillum soil application @ 2 kg ha^{-1} (T_{11}) recorded higher yield paramers, grain yield and straw yield as well as higher nutrient uptake. This treatment will be economical in sunflower in addition to improvement in soil fertility. Thus, it is agronomically feasible, ecologically desirable, practically applicable and economically viable technology paves the way for higher return $rupee^{-1}$ invested in sunflower.

Table 1 : Influence of integrated nutrient management practices on dry matter production and nutrient uptake of irrigated sunflower

Treatments	Dry matter production (kg ha^{-1})	Nutrient uptake (kg ha^{-1})		
		N	P	K
T_1 - Control	2216	38.32	5.32	50.58
T_2 – RDF (50:60:40 kg NPK ha^{-1})	2391	48.89	7.80	53.21
T_3- RDF + FYM @ 12.5 t ha^{-1}	2620	52.52	9.55	54.94
T_4 – RDF + $ZnSO_4$ @ 25 kg ha^{-1}	3272	57.42	12.55	60.28
T_5 – RDF + Azospirillum seed treatment @ 600 g ha^{-1}	3175	56.49	12.22	58.94
T_6 – RDF + Azospirillum soil application @ 2 kg ha^{-1}	3200	56.61	12.29	59.54
T_7 – T_3 + $ZnSO_4$ @ 25 kg ha^{-1}	4155	61.92	13.62	64.52
T_8 – T_3 + Azospirillum seed treatment @ 600 g ha^{-1}	3789	59.51	12.93	62.55
T_9 – T_3 + Azospirillum soil application @ 2 kg ha^{-1}	3858	59.74	13.20	62.73
T_{10} – T_3 + $ZnSO_4$ @ 25 kg ha^{-1} + Azospirillum seed treatment @ 600 g ha^{-1}	4682	63.50	14.38	67.17
T_{11} - T_3 + $ZnSO_4$ @ 25 kg ha^{-1} + Azospirillum soil application @ 2 kg ha^{-1}	4720	63.65	14.46	67.58
S. Ed	55.07	0.68	0.17	0.79
CD (p=0.05)	113.67	1.41	0.36	1.63

Table 2 : Influence of integrated nutrient management practices on number of filled seeds $capitulun^{-1}$, seed yield, stalk yield and economics of sunflower

Treatments	Number of filled seeds $capitulum^{-1}$	Seed yield (kg ha^{-1})	Stalk yield (kg ha^{-1})	Net income (Rs. ha^{-1})	Return $rupee^{-1}$ invested
T_1 - Control	246.0	548.32	1431.00	4941	1.37
T_2 – RDF (50:60:40 kg NPK ha^{-1})	318.0	889.57	2225.31	8582	1.54
T_3- RDF + FYM @ 12.5 t ha^{-1}	385.0	1210.14	2896.08	20262	2.01
T_4 – RDF + $ZnSO_4$ @ 25 kg ha^{-1}	688.0	1562.33	3573.33	29667	2.78
T_5 – RDF + Azospirillum seed treatment @ 600 g ha^{-1}	650.0	1549.00	3550.33	26572	2.66
T_6 – RDF + Azospirillum soil application @ 2 kg ha^{-1}	663.0	1550.32	3531.00	28702	2.76
T_7 – T_3 + $ZnSO_4$ @ 25 kg ha^{-1}	859.3	1838.36	3958.12	41417	2.99
T_8 – T_3 + Azospirillum seed treatment @ 600 g ha^{-1}	794.0	1703.33	3803.66	36202	2.80
T_9 – T_3 + Azospirillum soil application @ 2 kg ha^{-1}	805.0	1716.12	3825.33	37482	2.85
T_{10} – T_3 + $ZnSO_4$ @ 25 kg ha^{-1} + Azospirillum seed treatment @ 600 g ha^{-1}	923.3	1943.38	4231.00	44357	3.12
T_{11} - T_3 + $ZnSO_4$ @ 25 kg ha^{-1} + Azospirillum soil application @ 2 kg ha^{-1}	930.0	1953.00	4235.33	45537	3.16
S. Ed	21.85	20.91	54.11	–	–
CD (p=0.05)	45.10	43.17	108.26	–	–

References

Singh, J. and Singh, K.P. (2000). Effect of Azotobacter, FYM and fertility levels on yield, nitrogen recovery and use efficiency in spring sunflower. Haryana J. Agron., 16(1&2): 57-60.

Murthy, K.N.; Jayadeva, H.M.; Janardhan, C. and Ramachandra, C. (2011). Influence of different levels of nutrients on growth and yield of sunflower under irrigated condition of eastern dry zone of Karnataka. Karnataka J. Agric. Sci., 11(2): 1025-1028.

Panse, V.G. and Sukhatme, P.V. (1978). Statistical method for agricultural workers, ICAR, New Delhi, India, 145.

Rupapunithavathy, A. (2005). Response of sunflower cv. CO4 to biofertilizers. M.Sc. (Ag.) Thesis, Annamalai Univ., Annamalainagar, Tamil Nadu.

Shanmugasundaram, R. and Savithri, P. (2005). Effects of levels and frequency of zinc sulphate application on yield and DTPA-Zn availability In maize – sunflower cropping system. Madras Agric. J., 92(4-6): 252-257.

Venkatakrishnan, A.S. and Balasubramanian, N. (1996). Yield maximization in sunflower. Madras Agric. J., 83(2): 791-792.