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Nutrient uptake of Sunflower as influenced by enriched composts with N-P-K fertilizers

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Abstract

A pot experiment on sunflower cv. Sunbred was carried out to study the effect of different levels of chemical fertilizers and different enriched organic composts during April-July, 2017 at the pot culture yard of Department of Soil Science & Agricultural Chemistry, Annamalai University, Annamalaiagar. The initial soil available nitrogen, phosphorus, potassium status were 228 (low), 10.2 (low) and 317 (high) kg ha⁻¹, respectively. The study comprised the treatments of five levels of factor-A (EC₀-Control, EC₁-EFYM, EC₂-EWHC, EC₃-ENLC, EC₄-ESDC) and four levels of factor-B (CF₀-Control, CF₁-75% RDF, CF₂-100% RDF, CF₃-125% RDF) (20 treatment combinations), laid out in factorial completely randomized design (FCRD) with three replications. Sunflower cv. Sunbred was grown as a test crop and supplied with enriched composts and different levels of fertilizers as per the treatment schedule. Recommended dose of N:P₂O₅:K₂O for sunflower is 60:90:60 kg ha⁻¹ respectively were applied in the form of urea, SSP and MOP, respectively. The results revealed that application of enriched composts and different levels of chemical fertilizers significantly increased the nitrogen, phosphorus and potassium uptake by sunflower. Among the different treatments, the combined application of CF₃-125% RDF + enriched water hyacinth compost (EWHC) recorded the highest N, P and K uptake by sunflower were 1.63, 0.41 and 1.5 (g pot⁻¹), respectively.

Keywords: Sunflower, NPK uptake, chemical fertilizers, enriched composts

Introduction

The average productivity of oilseeds in India is around 1.0 t ha⁻¹, which was far below that of the world (1.9 t ha⁻¹), mainly due to their cultivation under rainfed condition, low input use and poor crop management (Suryavanshi, 2015) [9]. Enriched organic manures minimize the excess use of fertilizers for optimum yield and quality of crops without harming soil and environmental health (Vipen Bhadu *et al.*, 2017) [10]. Farm yard manure (FYM) is the most common, traditional organic manure used as soil amendment by the farmers in India and its nutritional value in increasing crop production is recognized from time immemorial. Enriched neem leaf compost is prepared by using neem leaves, farm yard manure, single super phosphates with microorganism and it can be used as an important soil conditioner. Compost has also been shown to suppress plant diseases, pest and enhances higher yield of agricultural crops (Adesina *et al.*, 2011) [1]. The neem leaf, fruit, oil and cake has important potential for insect control and nutrient content (Sivakumar *et al.*, 2002) [7]. Sawdust or wood dust is a by-product or waste product from wood working operations such as sawing, milling, drilling and sanding. It is composed of fine particles of wood. Saw dust mixed with manure or nitrogen supplement keeps the plant healthy. Water hyacinth (*Eichhornia crassipes* Mart.(Solms.) belonging to the family pontederiaceae, aptly known as the worst aquatic weed found abundantly in almost all types of wetlands varying from small fish ponds to big riverine lakes. This macrophyte is one of the most invasive aquatic weeds in the world causing a serious threat to biodiversity (Lata and Veenapani, 2011) [3].

Materials and Methods

A pot experiment was conducted during April-July, 2017 at the pot culture yard of Department of Soil Science & Agricultural Chemistry, Faculty of Agriculture, Annamalai University, Annamalaiagar. The initial soil of the pot experiment was sandy clay loam in texture with a pH of 7.4 and EC of 0.44 dSm⁻¹. The fertility status of soil with respect to nitrogen, phosphorus, potassium availability were 228 (low), 10.2 (low) and 317 (high) kg ha⁻¹, respectively.

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This experiment was conducted with the treatments of five levels of factor-A and four levels of factor-B (20 treatment combinations) laid out in factorial completely randomized design (FCRD) with three replications. Sunflower cv. sunbred was grown as a test crop and supplied with different enriched composts (Control, EFYM, EWHC, ENLC, ESDC) and different levels of fertilizers (Control, 75% RDF, 100% RDF and 125% RDF) as per the treatment schedule. The

recommended dose of N: P₂O₅:K₂O for sunflower is 60:90:60 kg ha⁻¹ respectively were applied in the form of urea, SSP and MOP, respectively. Half dose of N and entire dose of P₂O₅ and K₂O were applied basally and remaining quantity of N was applied at 30 DAS. The different levels of P₂O₅ (SSP) were used for enrichment with different organic manures and applied as basal.

Table 1: Treatment details of pot culture experiment with sunflower cv. Sunbred

Factor A- (Four levels)	CF ₀ -Control	CF ₁ -75% RDF	CF ₂ -100% RDF	CF ₃ - 125% RDF	
Factor B - (Five levels)	EC ₀ -Control	EC ₁ - EFYM	EC ₂ - EWHC	EC ₃ - ENLC	EC ₄ -ESDC

EFYM-Enriched farm yard manure, EWHC-Enriched water hyacinth compost, ENLC-Enriched neem leaf compost and ESDC-Enriched saw dust compost, CF-Chemical fertilizer, EC-Enriched compost.

Results and Discussion

Nitrogen uptake (g pot⁻¹)

There was a significant influence with different levels of chemical fertilizers and different enriched composts on nitrogen uptake by sunflower is furnished in table 2. An increase in the level of chemical fertilizer increased the nitrogen uptake by sunflower. Application of 125% RDF (CF₃) registered the higher nitrogen uptake (1.47 g pot⁻¹) and it was followed by the treatment (CF₂) 100% RDF (N and K₂O) (1.29 g pot⁻¹). However the lowest nitrogen uptake was recorded in control (0.74 g pot⁻¹). It was also observed from the results that, application of different enriched composts significantly influenced the nitrogen uptake of sunflower. Application of enriched water hyacinth compost (EC₂) recorded the highest nitrogen uptake (1.28 g pot⁻¹). It was followed by the treatment received enriched farm yard manure (EC₁) recorded the nitrogen uptake of 1.20 g pot⁻¹. The lowest nitrogen uptake of 0.98 g pot⁻¹ was recorded in control (EC₀).

The interaction effect between inorganic fertilizers and enriched composts on nitrogen uptake also was significant. Application of 125% RDF (N:K₂O) + 125% P₂O₅ (SSP) enriched water hyacinth compost (CF₃,EC₂) (T₁₈) recorded the highest nitrogen uptake (1.63 g pot⁻¹) by sunflower, it was followed by treatment (T₁₇) which received 125% RDF (N: K₂O) + 125% P₂O₅ (SSP) enriched farm yard manure (1.57 g pot⁻¹). The lowest nitrogen uptake (0.65 g pot⁻¹) was recorded in control.

The increased uptake of nitrogen might be ascribed due to application of nitrogen through inorganic fertilizers and enriched water hyacinth compost. With the efficient root system and plant growth, the soil nitrogen was absorbed and utilized effectively resulting in increased concentration and uptake of nitrogen in plant. Similar reports were expressed by Chaturvedi *et al.*, (2010) [2] and Sridevi (2012) [8].

Phosphorus uptake (g pot⁻¹)

The use of different levels of chemical fertilizers and different enriched composts to sunflower significantly increased the phosphorus uptake by sunflower and given in table 3.

Application of CF₀, CF₁, CF₂ and CF₃ registered the phosphorus uptake of 0.22, 0.29, 0.34 and 0.38 g pot⁻¹, respectively. Which received 0%RDF, 75%RDF, 100% RDF and 125%RDF of N, P₂O₅ and K₂O, respectively. Among the different levels of chemical fertilizers tried, 125% RDF (CF₃) recorded significantly highest nitrogen uptake of 0.38 g pot⁻¹.

It was also observed from the results that, application of different enriched composts significantly influenced the phosphorus uptake by sunflower. Application of enriched water hyacinth compost (EC₂) recorded the highest phosphorus uptake (0.34 g pot⁻¹). It was followed by the treatment received enriched farm yard manure (EC₁) registered phosphorus uptake of 0.32 g pot⁻¹. The lowest phosphorus uptake of 0.28 g pot⁻¹ was recorded in control (EC₀) which was not supplied with any enriched composts.

The interaction effect between inorganic fertilizers and enriched composts on phosphorus uptake was significant. Among the different combinations, application of 125% RDF (N: K₂O) + 125% P₂O₅ (SSP) enriched water hyacinth compost (T₁₈) (CF₃,EC₂) recorded the highest phosphorus uptake (0.41 g pot⁻¹), it was followed by the treatment (T₁₇) (CF₃,EC₁) 125% RDF (N: K₂O) + 125% P₂O₅ (SSP) enriched farm yard manure with the phosphorus uptake (0.40 g pot⁻¹). However the lowest phosphorus uptake (0.20 g pot⁻¹) was recorded in control. The results are in agreement with the findings of Mohanty *et al.*, (2006) [4].

Potassium uptake (g pot⁻¹)

The potassium uptake by sunflower significantly increased with the use of different levels of chemical fertilizers and different enriched composts and furnished in table 4. A significant increase in potassium uptake by sunflower was noticed with increase in chemical fertilizer levels up to 125% RDF. However, application of 125% RDF (CF₃) recorded the highest potassium uptake (1.54 g pot⁻¹). However, application of different treatments *viz.*, CF₀, CF₁, CF₂ and CF₃ registered the potassium uptake of 1.09, 1.29, 1.44 and 1.54 g pot⁻¹, respectively. Application of different enriched composts significantly influenced the potassium uptake by sunflower. Among the different enriched composts, application of enriched water hyacinth compost (EC₂) recorded the highest potassium uptake (1.43 g pot⁻¹) and the lowest potassium uptake of 1.25 g pot⁻¹ was found to be with control (EC₀). Whereas, the application of EFYM, ENLC and ESDC registered the potassium uptake of 1.39, 1.33 and 1.30 g pot⁻¹, respectively. Increased uptake of potassium by sunflower might be due to synergistic effect of fertilizer nutrients with enriched composts on phosphorus and potassium absorption and their utilization by the crop (Pingaleswaran, 2017) [6]. Naphade and Naphade (1992) [5] also reported an increase in N and K concentration and uptake by sunflower due to P application.

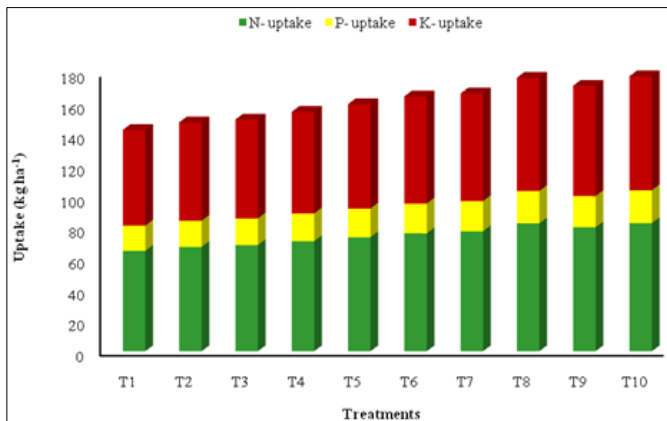


Fig 1: Effect of different combinations of inorganic fertilizers, EFYM, EWHC and NAA on N, P, K uptake (kg ha^{-1}) by sunflower cv. Sunbred

Table 2: Effect of different levels of chemical fertilizers and enriched composts on N uptake (g pot^{-1}) by sunflower cv. Sunbred

Chemical Fertilizers	N uptake (g pot^{-1})					
	Enriched Composts					
	EC ₀	EC ₁	EC ₂	EC ₃	EC ₄	Mean
CF ₀ –Control	0.65	0.79	0.84	0.73	0.71	0.74
CF ₁ – 75% RDF	0.90	1.04	1.17	0.98	0.96	1.01
CF ₂ –100% RDF	1.08	1.41	1.50	1.28	1.21	1.29
CF ₃ –125% RDF	1.31	1.57	1.63	1.48	1.39	1.47
Mean	0.98	1.20	1.28	1.11	1.06	1.12
Factors	EC		CF		EC X CF	
S.Ed	0.010		0.010		0.020	
CD ($p=0.05$)	0.027		0.022		0.05	

Table 3: Effect of different levels of chemical fertilizers and enriched composts on P uptake (g pot^{-1}) by sunflower cv. Sunbred

Chemical Fertilizers	P uptake (g pot^{-1})					
	Enriched Composts					
	EC ₀	EC ₁	EC ₂	EC ₃	EC ₄	Mean
CF ₀ –Control	0.20	0.24	0.25	0.22	0.22	0.22
CF ₁ – 75% RDF	0.26	0.30	0.33	0.28	0.28	0.29
CF ₂ –100% RDF	0.31	0.36	0.38	0.34	0.33	0.34
CF ₃ –125% RDF	0.35	0.40	0.41	0.38	0.37	0.38
Mean	0.28	0.32	0.34	0.30	0.30	0.30
Factors	EC		CF		EC X CF	
S.Ed	0.030		0.030		0.030	
CD ($p=0.05$)	0.077		0.072		0.015	

Table 4: Effect of different levels of chemical fertilizers and enriched composts on K uptake (g pot^{-1}) by sunflower cv. Sunbred

Chemical Fertilizers	K uptake (g pot^{-1})					
	Enriched Composts					
	EC ₀	EC ₁	EC ₂	EC ₃	EC ₄	Mean
CF ₀ –Control	1.01	1.14	1.18	1.08	1.06	1.09
CF ₁ – 75% RDF	1.22	1.32	1.38	1.29	1.27	1.29
CF ₂ –100% RDF	1.33	1.51	1.54	1.44	1.39	1.44
CF ₃ –125% RDF	1.45	1.59	1.65	1.54	1.49	1.54
Mean	1.25	1.39	1.43	1.33	1.30	1.34
Factors	EC		CF		EC X CF	
S.Ed	0.010		0.010		0.010	
CD ($p=0.05$)	0.020		0.020		0.040	

Conclusion

The study concluded that the nutrient uptake (N, P & K) by sunflower were significantly influenced by the application of different levels of chemical fertilizers and enriched composts. Application of 125% RDF (CF₃) registered the highest N, P and K uptake of 1.47, 0.38 and 1.54 g pot^{-1} , respectively.

Application of enriched water hyacinth compost (EWHC) (EC₂) recorded the maximum N, P and K uptake of 1.28, 0.38 and 1.54 g pot^{-1} , respectively. In the interaction study, the combined application of (CF₃.EC₂) (T₁₈) registered significantly highest nitrogen uptake (1.63 g pot^{-1}), phosphorus uptake (0.41 g pot^{-1}) and potassium uptake (1.65 g pot^{-1}) compared to (CF₀.EC₀).

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