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IMPACT OF INORGANIC AND ORGANIC SOURCES OF NUTRIENTS ON NPK UPTAKE BY AMBRETTE AND ITS POST-HARVEST SOIL NPK STATUS

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Abstract

The roots, leaves and seeds of ambrette are considered as valuable traditional medicines. The bitter, sweet, acrid, aromatic seeds are used as tonic and are considered to possess cooling, aphrodisiac, ophthalmic, cardiotonic, digestive, stomachiecm carminative, pectoral diuretic, stimulant, antispasmodic and deodorant properties. Crop removes nutrients continuously from soil and therefore, their replenishment though fertilizers and manures are essential. To find out the integrated effect of inorganic fertilizers, neem coated urea, enriched pressmud compost and sea weed extract on NPK uptake by ambrette and its post – harvest soil NPK status, a field investigation was carried out at Farmer's Field Sivapuri Village, Chidambaram Taluk, Cuddalore District during *Kharif*, 2018. The experiment was laid out in Randomized Block Design (RBD) with eight treatments and three replications. The crop was grown to maturity with proper cultural practices. The results revealed that application of integrated application of inorganic fertilizers, neem coated urea, enriched pressmud compost and sea weed extract resulted in significantly highest NPK uptake by ambretee and influenced the post – harvest soil fertility status with respect to available NPK.

Key words: Ambrette, nutrient uptake, soil available nutrients, organics, inorganic nutrients

Introduction

Soil is a storehouse of nutrients. An efficient management of soil as well as added nutrients is essential for maintaining soil fertility and sustaining the yield. Crop removes nutrients continuously from soil and therefore, their replenishment though fertilizers and manures are essential. The nutrient uptake may vary depends upon the crop, cultivar, nutrient level in soil, soil type, climate and management practices. Soil testing and plant analysis can help to provide the needed information for realizing optimum yield of crops under different soil situations (Nayyar and Sudhir, 2002). The ambrette seed contains an essential oil which gives a strong flowery musky odour of remarkable tenacity because of the presence of ambrettolide, a macrocyclic lactone in the seed coat. Ambrette seeds are exported to Canada, France, Nepal, Spain, UAE and United Kingdom to the extent of 116 quintals year^{-1}. The oil extracted from this crop has a great national and international demand (Rajeshwari and Arumugam Shakila, 2015). The combined application of organic manures and chemical fertilizers generally produces higher crop yield than when each is applied alone. Urea is the major sources of nitrogenous fertilizer used in agriculture. Neem coating in urea protects the loss of nitrogen by denitrification ensuring regulated continuous availability of nitrogen for longer period as per the requirement of crop. Composting of pressmud is a biological process in which organic material is decomposed by microbes and undergoes chemical and physical transformation to give a stable and humified end product is of value in agriculture both as an organic fertilizer and soil improver. Sea weed extract is a natural organic fertilizer highly nutritious, promotes faster seed germination and increase yield and resistant ability of crops (Thirumaran *et al.*, 2009). Considering the above said facts, a field experiment was conducted to explore the response of organic and inorganic sources of nutrients on NPK uptake by ambrette and its post-harvest NPK status in clay loam soil.

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Materials and Methods

The field investigation was carried out at Farmer's Field Sivapuri Village, Chidambaram Taluk, Cuddalore District during *Kharif*, 2018 to find out the integrated effect of inorganic fertilizers, neem coated urea, enriched pressmud compost and sea weed extract on NPK uptake by ambrette and its post – harvest soil NPK status. The experiment was laid out in Randomized Block Design (RBD) with three replications. There were eight treatments in different combinations of chemical fertilizers, neem coated urea, enriched pressmud compost and sea weed extract. Based on the results of physico-chemical analysis, the initial soil of the experimental field was sandy clay loam in texture with a pH of 7.6 and EC of 0.42 dSm^{-1}. The fertility status of soil with respect to N, P and K availability were 241.2 (low), 10. 1(low) and 323.2 (high) kg ha^{-1}, respectively. The main field was ploughed three times and brought to a fine tilth. Ambrette seeds were soaked in water for 12 hours before sowing and two seeds per hill were sown at the depth of one cm. The crop was grown to maturity with proper cultural practices. The field was supplied with neem coated urea, enriched pressmud compost, sea weed extract and inorganic fertilizers as per the treatment schedule. Recommended dose of $N:P_2O_5:K_2O$ for ambrette is 120:30:40 kg ha^{-1} were applied in the form of urea, SSP and MOP, respectively. The plant samples collected at harvest stage were chopped into pieces, dried in hot air-oven at 80^0C for eight hours and ground into powder in a Willey mill and the powdered samples were used for chemical analysis. After the harvest of ambrette, post – harvest soil samples from each treatment in each replication were collected, air-dried, powdered, sieved (2.0 mm) and analyzed for their nitrogen, phosphorus and potassium status based on the standard procedures.

Results and Discussion

Plant analysis

Nitrogen uptake (kg ha^{-1})

The various treatments significantly increased nitrogen uptake over control and its data given in table 1. The nitrogen uptake by different treatments ranged from 67.45 to 78.97 kg ha^{-1}. The treatment T_8 showed the highest nitrogen uptake of 78.97 kg ha^{-1} which received 75% RDF + N(NCU) + P(EPMC) + SWE. This was followed by T_6, T_7, T_5 and T_2 registered the nitrogen uptake of 77.79, 75.38, 73.82 and 70.30 kg ha^{-1}, respectively. The treatment T_6 - 75% RDF + N(NCU) + SWE was on par with T_7 which received 75% RDF + P(EPMC) + SWE. There was non significant difference was observed between T_5 - 75% RDF + N(NCU) + P(EPMC) and T_2 which received 100% RDF. However, the nitrogen uptake was least (67.45 kg ha^{-1}) was observed under control (T_1) which received no organic manures and inorganic fertilizers.

Table 1: Influence of integrated nutrients on N, P and K uptake by ambrette (kg ha^{-1}).

Treatments	N uptake (kg ha^{-1})	P uptake (kg ha^{-1})	K uptake (kg ha^{-1})
T_1- Absolute control	67.45	26.97	70.65
T_2 – 100% RDF	70.30	29.94	71.58
T_3-75% RDF –N (NCU)	68.36	28.91	70.83
T_4- 75% RDF –P(EPMC)	69.34	29.48	70.98
T_5-75% RDF –N (NCU) + P (EPMC)	73.82	30.09	71.93
T_6- T_3+SWE	77.79	30.45	72.52
T_7- T_4+SWE	75.38	30.63	72.39
T_8- T_5+SWE	78.97	30.86	72.59
S.Ed	0.44	0.07	0.06
CD=0.05	0.89	0.14	0.12

Application of (75% RDF –N(NCU) + P (EPMC) + SWE (T_8) resulted in significant increase in nitrogen uptake (78.97 kg ha^{-1}) by ambrette which could be due to increased crop growth. Control treatment (T_1) registered the lowest nitrogen uptake (67.45 kg ha^{-1}) of which might be interpreted as comparatively decreased in the growth and development and resulted low uptake. These results are in accordance with the findings of Agbede and Adekiya (2012). The increased nitrogen uptake might be due to the greater availability of nitrogen in soil which enhanced the growth of plants ultimately lead to higher accumulation of nutrients in their parts along with highest total uptake. The enhanced release of nitrogen from neem coated urea and enriched pressmud compost increased the nitrogen uptake by ambrette. This was also due to the balanced nutrition led to better uptake by ambrette. Neem cake blended urea maintained high available N status in the soil compared to other slow release forms of urea thus increased highest uptake compared prilled urea recorded the lowest uptake (Raj *et al.,* 2014). The use of sea weed extract significantly increased N uptake by ambrette, it was due to presence of marine bioactive substances in sea weed and higher stomata uptake efficiency in the treated plants as compared to the non-treated plants (Mancuso *et al.,* 2006). Similar result was observed by Abd-El Motty *et al.,* (2010) in soybean.

Phosphorus uptake (kg ha^{-1})

Similar to nitrogen uptake, phosphorus uptake by ambrette was also showed significant differences among various treatments. The phosphorus uptake was maximum (30.86 kg ha^{-1}) in T_8 (75% RDF + N(NCU) + P(EPMC) + SWE). The next best treatment T_7 (75% RDF + P(EPMC) + SWE) registered the phosphorus uptake of 30.63 kg ha^{-1} which was statistically on par with T_6 which received 75% RDF + N(NCU) + SWE (30.45 kg ha^{-1}). This was followed by T_5, T_2, T_4 and T_3 were recorded the phosphorus uptake of 30.09, 29.94, 29.48 and 28.91 kg ha^{-1}, respectively. However, the minimum phosphorus uptake (26.97 kg ha^{-1}) was found to be with control (T_1).

The lowest phosphorus uptake could be ascribed to the gradual decrease in the growth and performance of crop in control and resulted in less phosphorus content. The highest phosphorus uptake was also due to the incorporation of pressmud enhanced the availability of phosphorus to the ambrette crop. These findings were similar to Mathew and Kuruvilla (2005) who have reported that the microbial decomposition of added organic sources release several organic acids, which results in reduction in soil pH and solubilize soil nutrient which ultimately enhanced the uptake of the P. Sea weed extract from the species *Kappaphycus alvarezii* resulted in significant increases in P uptake in soybean when applied as foliar spray at vegetative and flowering stages (Rathore *et al*., 2007).

Potassium uptake (kg ha^{-1})

The potassium uptake due to different treatments ranged from 70.65 to 72.59 kg ha^{-1}. Among the treatments tried, application of 75% RDF + N(NCU) + P(EPMC) + SWE (T_8) recorded the highest potassium uptake (72.59 kg ha^{-1}). This was followed by 72.52 and 72.39 were noticed in T_6 and T_7, respectively. Which received 75% RDF + N(NCU) + SWE and 75% RDF + P(EPMC) + SWE, respectively. These two treatments were on par with each other. The next best potassium uptake of 71.93 and 71.58 were found to be with T_5 and T_2, respectively. However, the lowest potassium uptake (70.65 kg ha^{-1}) was noticed under T_1 which received no organic manures and inorganic fertilizers. This could be ascribed to the accumulation of dry matter content in plant in the above warranting higher potassium uptake. Availability of nitrogen increased the uptake of potassium. This is in accordance with findings of Yadav and Chhipa (2005) who had reported that pressmud based inorganic fertilizers treatment could have increased the exchangeable and water soluble potassium in the soil and supplying inorganic nutrient in more quantities thereby uptake of potassium by the ambrette crop was increased.

Table 2: Impact of integrated nutrients on post-harvest soil available NPK status.

Treatments	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
T_1- Absolute control	224.81	9.06	287.72
T_2 – 100% RDF	221.11	17.31	271.81
T_3-75% RDF –N (NCU)	215.24	18.02	262.42
T_4- 75% RDF –P(EPMC)	212.37	19.68	258.69
T_5-75% RDF –N (NCU) + P (EPMC)	209.81	17.82	241.01
T_6- T_3+SWE	203.45	15.58	232.12
T_7- T_4+SWE	196.68	15.09	228.23
T_8- T_5+SWE	192.27	13.67	216.85
S.Ed	2.62	0.5765	7.19
CD=0.05	5.24	1.153	14.38

Initial soil physico-chemical properties

The initial soil contained 43.70, 13.21, 12.42 and 29.69 per cent coarse sand, fine sand, silt and clay, respectively. The soil is classified texturally as sandy clay loam and taxonomically as *TypicUstifluvent.* The soil pH, EC and organic carbon content were 7.98, 0.62 dSm^{-1} and 2.94 g kg^{-1}, respectively. The soil available nitrogen, phosphorus and potassium status were 165.2 (low), 10.10 (low) and 323.2(high) kg ha^{-1}, respectively.

Post-harvest soil available NPK status

Soil available nitrogen (kg ha^{-1})

There was a significant influence between the treatments with respect to soil available nitrogen status. It was ranged between 192.27 to 224.81 kg ha^{-1}. The highest soil available nitrogen status (224.81 kg ha^{-1}) was noticed in T1 whereas the lowest was observed with T_8(75% RDF + N (NCU) + P(EPMC) + SWE) (192.27 kg ha^{-1}). Application of 75% RDF + N (NCU) (T_6) and 75% RDF + N (NCU) + P(EPMC) + SWE (T_7) were registered the soil available nitrogen status of 203.45 and 196.68 kg ha^{-1}, respectively. These treatments *viz*., T8, T6, T7 were on par with other. Application of 100% RDF (T_2) registered the soil available nitrogen status of 221.11 kg ha^{-1}. There was a significant different between T_2 and T_3 registered the soil available nitrogen status of 215.24 kg ha^{-1} which received 75% RDF + N (NCU). The increase in available nitrogen is might be attributed to the release of nitrogen to the soil because of low carbon : nitrogen ratio of pressmud after composting. It also produced congenial environment for soil organism involved in nitrogen transformation. This result was confirmed by (Kumar *et al.*, 2007).

Soil available phosphorus (kg ha^{-1})

Among the various treatments tested, the highest soil available phosphorus status of 23.06 was found to be with control treatment which received no organic manures and inorganic fertilizers. Whereas the lowest soil available phosphorus status of 10.67 kg ha^{-1} was observed in T_8 which received 75% RDF + N (NCU) + P(EPMC) + SWE. This was on par with T6 and T7 registered the soil available phosphorus status of 11.09 and 15.58, kg ha^{-1}, respectively. However, application of 100% RDF alone registered the soil available phosphorus status of 21.31 kg ha^{-1} which was significantly differed with 14.68 kg ha^{-1} was found to be with T4 which received 75% RDF + P(EPMC). This might be attributed to the release of phosphorus from enriched presmmudcompost and inorganic fertilizers and higher phosphorus uptake by ambrette. (Babitha, 1999). The available phosphorus content of the soil was increased to 19.68 kg ha^{-1} (T_4) due to the addition of organic sources and inorganic fertilizers. The reason might be due to slow releasing nature of organics. (Poonkodi, 2004).

Soil available potassium (kg ha^{-1})

Application of different combinations of inorganic fertilizers, neem coated urea, enriched pressmud compost and sea weed extract significantly influenced available potassium status in the post-harvest soil of ambrette. It was ranged from 216.85 to 287.72 kg ha^{-1}. The control treatment (T_1) showed the highest soil available potassium status (287.72 kg ha^{-1}). The treatments T_2, T_3 and T_4 registered the soil available potassium status of 271.81, 262.42 and 258.69 kg ha^{-1}. The treatment T_1 statistically significant with T_2, whereas the treatment T_2 was on par with T_3 and T_4. However, the lowest soil available potassium status of 216.85 kg ha^{-1} was found to be with T_8 which received 75% RDF + N (NCU) + P(EPMC) + SWE.. This was due to supply of potassium from enriched pressmud compost and inorganic fertilizers. This was accordance with the finding of Babitha (1999) and Pingaleswaran (2017).

Conclusion

Soil is a storehouse of nutrients. An efficient management of soil as well as added nutrients is essential for maintaining soil fertility and sustaining the yield. The nitrogen, phosphorus and potassium uptake by ambrette due to different treatments, ranged between 67.45 – 78.97, 26.97-30.86 and 70.65 – 72.59 kg ha^{-1}, respectively. The highest N, P and K uptake were found to be with T_8. With respect to soil fertility status, nitrogen, phosphorus and potassium availability in the post- harvest soil of ambrette was significantly influenced due to different treatments. Hence, from the field experiment, it is concluded that application of 75% RDF + N(neem coated urea) + P (enriched pressmud compost @ 1000 kg ha^{-1}) and sea weed extract @5% three sprays at 30 days interval markedly increased NPK uptake by ambrette and its post - harvest soil NPK status.

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