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Influence of Organic and Inorganic Sources of Nutrient on Nutrient Content and Uptake by *Tikhur* (*Curcuma aungustifolia* Roxb.) Grown in *Inceptisol* of Chhattisgarh Plateau

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A B S T R A C T

The investigation was undertaken during kharif season 2016 at Shaheed Gundadhoor College of Agriculture and Research Station, Jagdalpur (Chhattisgarh). The experiment was laid out in a factorial randomized complete block design with the treatments comprised of four levels of fertilizers ($N_0P_0K_0$, $N_{30}P_{20}K_{30}$, $N_{60}P_{40}K_{60}$ and $N_{90}P_{60}K_{90}$ kg ha^{-1}) and four levels of vermicompost (0, 10, 20 and 30 t ha^{-1}) and three replications. Application of vermicompost up to 20 t ha^{-1} and fertilizers up to $N_{60}P_{40}K_{60}$ kg ha^{-1} had significant effect on content and uptake of nitrogen, phosphorus and potassium except potassium uptake by tuber and haulm which was increased successively with increased fertilizers and vermicompost levels, respectively. The total uptake of NPK by tikhur ranges from 43.2-127.0, 18.3-32.9 and 59.9-113.6 kg ha^{-1}, respectively due to varying levels of organic and inorganic nutrients. The interaction effect of fertilizer with vermicompost was found significant in case of nitrogen uptake by tuber and total nitrogen uptake only. The combination of fertilizer @ $N_{60}P_{40}K_{60}$ with vermicompost @ 20 t ha^{-1} is found superior as it recorded N uptake either higher or at par with other combinations and also saves cost on fertilizer and vermicompost.

Introduction

Tikhur (*Curcuma angustifolia*; family Zingiberaceae) also known as white turmeric or East Indian arrowroot is a rhizomatous herb,which is considered as a minor tuber crop having medicinal value, grows well under shaded conditions, cultivated in many parts of the statesof Madhya Pradesh, Chhattisgarh and Jharkhand under moist deciduous mixed and *sal* forest. Its economic part is rhizome, which is used for the production of starch, valued as a food especially for infants, invalids and convalescents.

Additions of inorganic and organic nutrients are not only improves yield and quality of tuber and other crops but also exert significant influence on physical, chemical and biological properties of soil (Ramesan *et al.*, 1996, Maheswarappa *et al.*, 2000, Love, *et al.*, 2005, Haase, *et al.*, 2007 and Alam, 2007). The information on influence of organic and inorganic sources of nutrientson NPK content and uptake by *Tikhur* is meager. Hence a field investigation was initiated to evaluate the influence of organic and inorganic sources of nutrients on NPK content

and uptake by Tikhur (*Curcuma aungustifolia* Roxb.) in *Inceptisols* of Chhattisgarh plateau.

Materials and Methods

The investigation was undertaken during the *kharif* season of 2016 at Indira Gandhi Krishi Vishwavidyalaya, Shaheed Gundadhoor College of Agriculture and Research Station, Jagdalpur, Bastar (Chhattisgarh). The experiment was laid out in a factorial randomized complete block design with the treatments comprised of four levels of fertilizers ($N_0P_0K_0$, $N_{30}P_{20}K_{30}$, $N_{60}P_{40}K_{60}$ and $N_{90}P_{60}K_{90}$ kg ha^{-1}) and four levels of vermicompost (0, 10, 20 and 30 t ha^{-1}) and three replications.

The experimental soil was loamy in texture, comes under *Inceptisols* order and had initial soil physicochemical properties like 46 % sand, 30 % silt, 24 % clay, 5.5 pH, 0.03 dSm^{-1} electrical conductivity, 0.71 % organic carbon, 1.43g cm^{-3} bulk density, 14.5 C mol (p+) kg^{-1} cation exchange capacity, 202.2 kg ha^{-1} available N, 13.9 kg ha^{-1} available P, 206 kg ha^{-1} available K, 16.6 kg ha^{-1} available S, 2.51 meq/100 g available Ca, 1.82 meq/100 g soil available Mg.

The nutritional composition of vermicompost used in the study was 1.4 % N, 0.6 % P and 1.1 % K. The planting of *Tikhur* was done on May 17, 2016. Full dose of vermicompost, phosphorus and potassium and 1/3 dose of nitrogen, as per treatment, were applied in the form of diammonium phosphate, *muriate* of potash and urea, at the time of planting and the remaining dose of nitrogen was applied at 60 and 75 days after planting. The intercultural operation like, hand weeding done three times at 60, 90 and 120 days after planting, earthing up done at 110 days after planting, spraying of macoban (carbendazim + mancozeb) fungicide for the control of blight disease at 100 days after sowing and crops are grown in rainfed field conditions. The crop was harvested at 30 December 2016 after complete maturity, as indicated by the leaf drying and falling down of plants.

For analysis of NPK content 0.5 g of dry well prepared plant samples are taken. The NPK uptake was calculated separately by multiplying their contents in tubers and haulm of *tikhur* with yield of tubers and haulm of *tikhur*. Total uptake of NPK was calculated separately by adding both components *i.e* uptake by tuber and uptake by haulm. The plant samples digested material was distilled by automatic KEL plus system and nitrogen content was determined using method as described by Chapman and Pratt (1961), phosphorus content was determined by vanadomolybdo-phosphoric acid yellow color complex method as described by Jackson (1973) and potassium content was determined by flame photometer as described by Chapman and Pratt (1961).

Results and Discussion

Nitrogen content in tuber

The data presented in table 1 revealed that the organic and inorganic nutrients individually had significant effect on nitrogen content in tuber, however, interaction of fertilizer with vermicompost was not found significant. Nitrogen content in the tuber ranges from 0.98 to1.08% with the highest value due to application of fertilizer @ $N_{90}P_{60}K_{90}$kg ha^{-1} and vermicompost @ 30 t ha^{-1}. The nitrogen content in tuber was significantly higher due to application of fertilizer @ $N_{90}P_{60}K_{90}$kg ha^{-1} as compared to$N_0P_0K_0$ and $N_{30}P_{20}K_{30}$kg ha^{-1} but at par with fertilizer @ $N_{60}P_{40}K_{60}$kg ha^{-1}, similarly, application of vermicompost @ 30 t ha^{-1}had recorded significantly higher nitrogen content in tuber than vermicompost @ 0 and 10 t ha^{-1}butit was at par with vermicompost @ 20 t ha^{-1}.

Nitrogen content in haulm

The data presented in table 1 revealed that the organic and inorganic nutrients individually had significant effect on nitrogen content in haulm of *tikhur* but their interaction was not found significant.

Nitrogen content in the haulm of *tikhur* ranges from 0.41 to 0.49 % and 0.40 to 0.49% with the highest value due to application of fertilizer @ $N_{90}P_{60}K_{90}$kg ha^{-1} and vermicompost @ 30 t ha^{-1}, respectively. The nitrogen content in haulm of *tikhur* was significantly higher due to application of fertilizer @ $N_{90}P_{60}K_{90}$ kg ha^{-1} as compared to $N_0P_0K_0$ and $N_{30}P_{20}K_{30}$kg ha^{-1} but it was at par with fertilizer @ $N_{60}P_{40}K_{60}$kg ha^{-1}, similarly, application of vermicompost @ 30 t ha^{-1}had significantly higher nitrogen content in haulm of *tikhur* as compared to vermicompost @ 0 and 10 t ha^{-1}but it was at par with vermicompost @ 20 t ha^{-1}.

Nitrogen uptake by tuber

The data presented in table 1 and 4 revealed a significant individual and interaction effect of organic and inorganic nutrients on nitrogen uptake by tubers of *tikhur*. The nitrogen uptake by tubers of *tikhur* ranges from 61.3 to 113.5 kg ha^{-1} and 75.3to 105.6kg ha^{-1} with the highest value due to application of fertilizer @ $N_{90}P_{60}K_{90}$kg ha^{-1} and vermicompost @ 30 t ha^{-1}, respectively.

Significantly higher nitrogen uptake by tubers of *tikhur* was recorded due to application of fertilizer@ $N_{90}P_{60}K_{90}$kg ha^{-1} as compared to $N_0P_0K_0$ and $N_{30}P_{20}K_{30}$kg ha^{-1} but it was at par with $N_{60}P_{40}K_{60}$kg ha^{-1}, similarly, the nitrogen uptake by tubers of *tikhur* was significantly higher due to application of vermicompost @ 30 t ha^{-1} as compared to vermicompost @ 0 and 10 t ha^{-1} but it was at par with vermicompost @ 20 t ha^{-1}.

In case of interaction effect, the nitrogen uptake by tubers of *tikhur* was increased under all the fertilizer levels as we increased vermicompost levels up to 20 t ha^{-1}, increasing vermicompost levels, their after, did not increase nitrogen uptake by tuber, significantly. Similarly, the nitrogen uptake by tubers of *tikhur* was increased under all the vermicompost levels as we increased fertilizer levels up to $N_{60}P_{40}K_{60,}$ increasing fertilizer level further did not statistically increase the nitrogen uptake by tubers. The higher nitrogen uptake by tuber 123.7 kg ha^{-1} was achieved due to application of 30 t ha^{-1} vermicompost with fertilizer @$N_{90}P_{60}K_{90}$kg ha^{-1} which was statistically at par with fertilizer @ $N_{60}P_{40}K_{60}$ with vermicompost @ 30 t ha^{-1}, fertilizer @ $N_{90}P_{60}K_{90}$ with vermicompost @ 20 t ha^{-1} and fertilizer @ $N_{60}P_{40}K_{60}$ with vermicompost @ 20 t ha^{-1}. It can be concluded that combination of fertilizer @ $N_{60}P_{40}K_{60}$ with vermicompost @ 20 t ha^{-1} is superior as it saves cost on fertilizer and vermicompost.

Nitrogen uptake by haulm

The data presented in table 1 revealed that the organic and inorganic nutrients individually had significant effect on nitrogen uptake by haulm of *tikhur*, however, their interaction was not found significant.

The nitrogen uptake by haulm ranges from 2.15 to 2.96kg ha^{-1} and 2.08 to 2.94kg ha^{-1} with the highest value due to application of fertilizer @ $N_{90}P_{60}K_{90}$kg ha^{-1} and vermicompost @ 30 t ha^{-1}, respectively. The nitrogen uptake by haulm was significantly higher due to application of fertilizer @ $N_{90}P_{60}K_{90}$ kg ha^{-1} as compared to $N_0P_0K_0$ and $N_{30}P_{20}K_{30}$kg ha^{-1} but it was at par with$N_{60}P_{40}K_{60}$kg ha^{-1}, similarly, application of vermicompost @ 30 t ha^{-1} had significantly higher nitrogen uptake by haulm than 0 and 10 t ha^{-1} but it was at par with 20 t ha^{-1}.

Total nitrogen uptake

The data presented in table 1 and 4 revealed that the organic and inorganic nutrients had significant individual and interaction effect on total nitrogen uptake by *tikhur*. The total nitrogen uptake ranges from 63.4 to 116.5kg $ha^{-1}$and 77.4 to 108.5kg $ha^{-1}$with the highest value due to application of fertilizer @ $N_{90}P_{60}K_{90}$kg ha^{-1} and vermicompost @ 30 t ha^{-1}, respectively.

The total nitrogen uptake due to application of fertilizer @ $N_{90}P_{60}K_{90}$kg ha^{-1} was significantly higher than $N_0P_0K_0$ and $N_{30}P_{20}K_{30}$ kg ha^{-1} but at par with $N_{60}P_{40}K_{60}$ kg ha^{-1}, similarly, application of vermicompost @ 30 t ha^{-1} had significantly higher total nitrogen uptake as compared tovermicompost @ 0 and 10 t ha^{-1} but at par with vermicompost @ 20 t ha^{-1}.

In case of interaction effect, the total nitrogen uptake of *tikhur* was increased significantly under all the fertilizer levels, as we increased vermicompost levels up to 20 t ha^{-1}, increasing vermicompost levels, their after, did not increase total nitrogen uptake significantly.

Similarly, the total nitrogen uptake of *tikhur* was increased significantly under all the vermicompost levels, as we increased fertilizer levels up to $N_{60}P_{40}K_{60,}$ increasing fertilizer level further did not statistically increase the total nitrogen uptake.

The higher total nitrogen uptake 127 kg ha^{-1} was achieved due to application of vermicompost @ 30t $ha^{-1}$with fertilizer @ $N_{90}P_{60}K_{90}$kg ha^{-1} which was statistically at par with fertilizer @ $N_{60}P_{40}K_{60}$ and vermicompost @ 30 t ha^{-1}, fertilizer @ $N_{90}P_{60}K_{90}$ and vermicompost @ 20 t ha^{-1} and fertilizer @ $N_{60}P_{40}K_{60}$ with vermicompost @ 20 t ha^{-1}. It can be concluded that combination of fertilizer @ $N_{60}P_{40}K_{60}$ with vermicompost @ 20 t ha^{-1} is superior as it saves cost on fertilizer and vermicompost.

The similar findings were also recorded by several workers. Yourtchi *et al.,* (2013) reported significantly higher nitrogen, potassium and phosphorous content of tuber due to application of 150 kg N ha^{-1} and vermicompost @12t ha^{-1} in comparison to control.

Bashir and Qureshi (2014) reported that concentration of N, P and K in tubers increased with increasing levels of N and FYM. Laxminarayana (2013) reported significantly higher total uptake of N (77.7 kg ha^{-1}) due to integrated use of nutrients with an uptake response of 178% over control.

Phosphorus content in tuber

The data presented in table 2 revealed that the application of organic nutrients had significant effect on phosphorus content in tuber, however, application of inorganic nutrients and interaction of organic and inorganic nutrients was not found significant. The phosphorus content in tuber ranges from 0.27 to 0.32% with the highest value due to application of vermicompost @ 30t ha^{-1}, which was significantly higher than 0 and 10t ha^{-1}but at par with 20 t ha^{-1}.

Phosphorus content in haulm

The data presented in table 2 revealed that the organic nutrients had significant effect on phosphorus content in haulm, however, effect of inorganic nutrients and interaction of organic and inorganic nutrients were not found significant.

The phosphorus content in haulm ranges from 0.09 to 0.12% with the highest value due to application of vermicompost @ 30 t ha^{-1}, which was significantly higher than 0 and 10t ha^{-1} but at par with 20 t ha^{-1}.

Table.1 Effect of graded doses of inorganic and organic sources of nutrients on N content and uptake by *Tikhur*

Inorganic/ Organic dose	N content in tuber (%)	N content in haulm (%)	Nuptake by tuber (kg ha^{-1})	N uptake by haulm (kg ha^{-1})	Total N uptake (kg ha^{-1})
$N_0P_0K_0$	0.98^{a}	0.41^{a}	61.3^{a}	2.2^{a}	63.4^{a}
$N_{30}P_{20}K_{30}$	1.00^{a}	0.43^{a}	86.7^{b}	2.3^{a}	89.0^{b}
$N_{60}P_{40}K_{60}$	1.07^{b}	0.48^{ba}	111.6^{c}	2.7^{b}	114.3^{c}
$N_{90}P_{60}K_{90}$	1.08^{b}	0.49^{b}	113.5^{c}	3.0^{b}	116.5^{c}
CD(P=0.05)	0.03	0.06	2.6	0.4	2.6
Vermicompost @ 0 t ha^{-1}	0.98^{a}	0.40^{a}	75.3^{a}	2.1^{a}	77.4^{a}
Vermicompost @ 10 t ha^{-1}	1.01^{a}	0.44^{a}	88.6^{b}	2.4^{a}	91.0^{b}
Vermicompost @ 20 t ha^{-1}	1.07^{b}	0.47^{ba}	103.6^{c}	2.7^{ba}	106.3^{c}
Vermicompost @ 30 t ha^{-1}	1.08^{b}	0.49^{b}	105.6^{c}	2.9^{b}	108.5^{c}
CD(P=0.05)	0.03	0.06	2.6	0.4	2.6
Interaction CD(P=0.05)	N.S.	N.S.	5.12	N.S.	5.20
CV (%)	3.54	22.22	3.29	18.96	7.97

Same small letter in a column have no significant difference as per *Duncan's* Multiple Range Test.

Table.2 Effect of graded doses of inorganic and organic sources of nutrients on Pcontent and uptake by *Tikhur*

Inorganic/ Organic dose	P content in tuber (%)	P content in haulm (%)	P uptake by tuber (kg ha^{-1})	P uptake by haulm (kg ha^{-1})	Total P uptake (kg ha^{-1})
$N_0P_0K_0$	0.28	0.10	17.8^{a}	0.50^{a}	18.3^{a}
$N_{30}P_{20}K_{30}$	0.29	0.11	25.1^{b}	0.57^{a}	25.7^{b}
$N_{60}P_{40}K_{60}$	0.30	0.11	31.4^{c}	0.61^{ba}	32.0^{c}
$N_{90}P_{60}K_{90}$	0.31	0.11	32.2^{c}	0.68^{b}	32.9^{c}
CD(P=0.05)	N.S.	N.S.	1.8	0.11	1.9
Vermicompost @ 0 t ha^{-1}	0.27^{a}	0.09^{a}	20.9^{a}	0.49^{a}	21.4^{a}
Vermicompost @ 10 t ha^{-1}	0.29^{a}	0.10^{a}	25.3^{b}	0.53^{a}	25.8^{b}
Vermicompost @ 20 t ha^{-1}	0.30^{ba}	0.11^{ba}	29.4^{c}	0.63^{ba}	30.1^{c}
Vermicompost @ 30 t ha^{-1}	0.32^{b}	0.12^{b}	30.9^{c}	0.72^{b}	31.6^{c}
CD(P=0.05)	0.02	0.01	1.8	0.11	1.9
Interaction CD(P=0.05)	N.S.	N.S.	N.S.	N.S.	N.S.
CV (%)	8.75	17.39	8.26	23.97	8.26

Same small letter in a column have no significant difference as per *Duncan's* Multiple Range Test.

Table.3 Effect of graded doses of inorganic and organic sources of nutrients on K content and uptake by *Tikhur*

Inorganic/ Organic dose	K content in tuber (%)	K content in haulm (%)	K uptake by tuber (kg ha^{-1})	K uptake by haulm (kg ha^{-1})	Total K uptake (kg ha^{-1})
$N_0P_0K_0$	0.94^{a}	0.10^{a}	59.4^{a}	0.50^{a}	59.9^{a}
$N_{30}P_{20}K_{30}$	0.99^{a}	0.11^{b}	85.3^{b}	0.60^{b}	85.8^{b}
$N_{60}P_{40}K_{60}$	1.02^{ba}	0.13^{c}	106.4^{c}	0.74^{c}	107.2^{c}
$N_{90}P_{60}K_{90}$	1.07^{b}	0.14^{c}	112.9^{d}	0.83^{c}	113.6^{c}
CD(P=0.05)	0.06	0.01	6.3	0.09	6.4
Vermicompost @ 0 t ha^{-1}	0.92^{a}	0.10^{a}	70.9^{a}	0.51^{a}	71.4^{a}
Vermicompost @ 10 t ha^{-1}	0.98^{a}	0.11^{b}	86.0^{b}	0.62^{b}	86.6^{b}
Vermicompost @ 20 t ha^{-1}	1.03^{ba}	0.13^{c}	100.4^{c}	0.72^{c}	101.1^{c}
Vermicompost @ 30 t ha^{-1}	1.08^{b}	0.14^{c}	106.5^{c}	0.82^{d}	107.4^{c}
CD(P=0.05)	0.06	0.01	6.3	0.09	6.4
Interaction CD(P=0.05)	N.S.	N.S.	N.S.	N.S.	N.S.
CV (%)	10.0	15.14	6.02	14.93	8.33

Same small letter in a column have no significant difference as per *Duncan's* Multiple Range Test.

Table.4 Interaction effect of graded doses of inorganic and organic sources of nutrients on N uptake by *Tikhur*

Fertilizer levels (kg ha^{-1})	Vermicompost levels (t ha^{-1})				Interaction CD (*P=0.05*)
	0	10	20	30	
N uptake by tuber (kg ha^{-1})					
$N_0P_0K_0$	41.5^{aA}	54.6^{aB}	73.6^{aC}	75.4^{aC}	5.1
$N_{30}P_{20}K_{30}$	63.6^{bA}	82.1^{bB}	99.3^{bC}	101.7^{bC}	
$N_{60}P_{40}K_{60}$	96.8^{cA}	107.6^{cB}	120.2^{cC}	121.6^{cC}	
$N_{90}P_{60}K_{90}$	99.3^{cA}	109.9^{cB}	121.2^{cC}	123.7^{cC}	
Total N uptake (kg ha^{-1})					
$N_0P_0K_0$	43.2^{aA}	56.6^{aB}	75.9^{aC}	78.0^{aC}	5.2
$N_{30}P_{20}K_{30}$	65.5^{bA}	84.3^{bB}	101.7^{bC}	104.4^{bC}	
$N_{60}P_{40}K_{60}$	99.0^{cA}	110.2^{cB}	123.2^{cC}	124.7^{cC}	
$N_{90}P_{60}K_{90}$	101.8^{cA}	112.7^{cB}	124.4^{cC}	127.0^{cC}	

Same capital letter in a row and small letter in a column have no significant difference as per *Duncan's* Multiple Range Test.

Phosphorus uptake by tuber

The data presented in table 2 revealed that the organic and inorganic nutrients individually had significant effect on phosphorus uptake by tuber but their interaction was not found significant. The phosphorus uptake by tuber ranges from 17.8 to 32.2 kg ha^{-1} and 20.9to 30.9kg ha^{-1}, with the highest value due to application of fertilizer @ $N_{90}P_{60}K_{90}$kg ha^{-1} and vermicompost @ 30 t ha^{-1}, respectively. The phosphorus uptake by tuber was significantly higher due to application of fertilizer @ $N_{90}P_{60}K_{90}$kg ha^{-1} as compared to $N_0P_0K_0$ and $N_{30}P_{20}K_{30}$kg ha^{-1} but at par with $N_{60}P_{40}K_{60}$kg ha^{-1}, similarly, phosphorus

uptake by tuber was significantly higher due to application of vermicompost @ 30 t ha^{-1}as compared to 0 and 10 t ha^{-1}but at par with 20 t ha^{-1}.

Phosphorus uptake by haulm

The data presented in table 2 revealed that the organic and inorganic nutrients individually had significant effect on phosphorus uptake by haulm, however, their interaction was not found significant. The phosphorus uptake by haulm ranges from 0.50 to 0.68kg ha^{-1} and 0.49 to 0.72kg ha^{-1} with the highest value due to application of fertilizer @ $N_{90}P_{60}K_{90}$kg ha^{-1} and vermicompost @ 30 t ha^{-1}, respectively. The phosphorus uptake by haulm was significantly higher due to application of fertilizer @ $N_{90}P_{60}K_{90}$ kg ha^{-1} as compared to $N_0P_0K_0$ and $N_{30}P_{20}K_{30}$ kg ha^{-1} but at par with $N_{60}P_{40}K_{60}$ kg ha^{-1}, similarly, phosphorus uptake by haulm was significantly higher due to application of vermicompost @ 30 t ha^{-1} as compared to 0 and 10 t ha^{-1} but at par with 20 t ha^{-1}.

Total phosphorus uptake

The data presented in table 2 revealed that the organic and inorganic nutrients individually had significant effect on total phosphorus uptake, however, their interaction was not found significant. The total phosphorus uptake ranges from 18.3 to 32.9 kg ha^{-1} and 21.4 to 31.6 kg ha^{-1} with the highest value due to application of fertilizer @ $N_{90}P_{60}K_{90}$kg ha^{-1} and vermicompost @ 30 t ha^{-1}. The total phosphorus uptake was significantly higher due to application of fertilizer @ $N_{90}P_{60}K_{90}$kg ha^{-1}as compared to $N_0P_0K_0$ and $N_{30}P_{20}K_{30}$kg ha^{-1}but at par with $N_{60}P_{40}K_{60}$kg ha^{-1}, similarly, application of vermicompost @ 30 t ha^{-1} was significantly higher than 0 and 10 t $ha^{-1}$and at par with 20 t ha^{-1}. The similar findings were also reported by several workers. The concentration of N, P and K in tubers increased with increasing levels of N and FYM (Bashir and Qureshi, 2014). Yourtchi *et al.*, (2013) reported that effects of different nitrogen rates and vermicompost application significantly improved NPK content of tuber compared with nitrogen or vermicompost alone treatments. Laxminarayana (2013) reported that total uptake of P was the highest due to integrated use of nutrients.

Potassium content in tuber

The data presented in table 3 revealed that the organic and inorganic nutrients individually had significant effect on potassium content in tuber but their interaction was not found significant. The potassium content in tuber ranges from 0.94 to1.07% and 0.92 to1.08%with the highest value due to application of fertilizer @ $N_{90}P_{60}K_{90}$kg ha^{-1} and vermicompost @ 30t ha^{-1}, respectively. The potassium content in tuber was significantly higher due to application of fertilizer @ $N_{90}P_{60}K_{90}$kg ha^{-1} as compared to $N_0P_0K_0$ and $N_{30}P_{20}K_{30}$kg ha^{-1} but at par with $N_{60}P_{40}K_{60}$kg ha^{-1}, similarly, potassium content in tuber was found significantly higher due to application of vermicompost @ 30t ha^{-1} as compared to 0 and 10 t ha^{-1} but at par with 20 t ha^{-1}.

Potassium content in haulm

The data presented in table 3 revealed that the organic and inorganic nutrients individually had significant effect on potassium content in haulm but their interaction was not found significant. Potassium content in haulm ranges from 0.10 to 0.14% with the highest value due to application of fertilizer@ $N_{90}P_{60}K_{90}$ kg ha^{-1} and vermicompost @ 30t ha^{-1}. The potassium content in haulm was significantly higher due to application of fertilizer @ $N_{90}P_{60}K_{90}$kg ha^{-1} as compared to$N_0P_0K_0$ and $N_{30}P_{20}K_{30}$kg ha^{-1} but at par with

$N_{60}P_{40}K_{60}$kg ha^{-1}, similarly, potassium content in haulm was found significantly higher due to application of vermicompost @ 30 t ha^{-1} as compared to 0 and 10 t ha^{-1} but at par with 20 t ha^{-1}.

Potassium uptake by tuber

The data presented in table 3 revealed that the organic and inorganic nutrients individually had significant effect on potassium uptake by tuber, however, their interaction was not found significant.

The potassium uptake by tuber ranges from 59.4 to 112.9 kg ha^{-1} and 70.9to 106.5kg ha^{-1} with the highest value due to application of fertilizer @ $N_{90}P_{60}K_{90}$kg ha^{-1} and vermicompost @ 30 t ha^{-1}, respectively. Potassium uptake by tuber increased significantly at all successive fertilizer levels from $N_0P_0K_0$to $N_{30}P_{20}K_{30}$kg ha^{-1}, $N_{30}P_{20}K_{30}$ to $N_{60}P_{40}K_{60}$ and $N_{60}P_{40}K_{60}$to $N_{90}P_{60}K_{90}$kg ha^{-1}. Whereas, potassium uptake by tuber was significantly higher due to application of vermicompost @ 30t ha^{-1}as compared to 0 and 10 t ha^{-1}but at par with 20 t ha^{-1}.

Potassium uptake by haulm

The data presented in table 3 revealed that the organic and inorganic nutrients individually had significant effect on uptake by haulm but their interaction was not found significant. The potassium uptake by haulm ranges from 0.50 to 0.83kg ha^{-1}and 0.51 to 0.82kg ha^{-1} with the highest value due to application of fertilizer @ $N_{90}P_{60}K_{90}$kg ha^{-1} and vermicompost @ 30 t ha^{-1}, respectively. The potassium uptake by haulm was significantly higher due to application of fertilizer @ $N_{90}P_{60}K_{90}$ kg ha^{-1} as compared to $N_0P_0K_0$ and $N_{30}P_{20}K_{30}$ kg ha^{-1} but at par with $N_{60}P_{40}K_{60}$ kg ha^{-1}. Whereas, Potassium uptake by haulm increased significantly at all successive vermicompost levels from 0 to 10, 10 to 20 and 20to 30t ha^{-1}.

Total potassium uptake

The data presented in table 3 revealed that the organic and inorganic nutrients individually had significant effect on total potassium uptake, however, their interaction was not found significant. The total potassium uptake ranges from 59.9 to 113.6kg ha^{-1} and 71.4to 107.4kg ha^{-1} with the highest value due to application of fertilizer @ $N_{90}P_{60}K_{90}$kg ha^{-1} and vermicompost @ 30 t ha^{-1} respectively. The total potassium uptake was significantly higher due to application of fertilizer @ $N_{90}P_{60}K_{90}$kg ha^{-1} as compared to $N_0P_0K_0$ and $N_{30}P_{20}K_{30}$ kg ha^{-1} but at par with $N_{60}P_{40}K_{60}$ kg ha^{-1}, similarly, total potassium uptake was found significantly higher due to application of vermicompost @ 30 t ha^{-1} as compared to 0 and 10 t ha^{-1} but at par with 20 t ha^{-1}.

The similar findings were also recorded by Yourtchi *et al.,* (2013), Bashir and Qureshi (2014) and Laxminarayana (2013).

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