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EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON YIELD AND ECONOMICS OF TURMERIC GROWN IN NAGALAND

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ABSTRACT

Field experiments were carried out at the Experimental Farm, Department of Horticulture, School of Agricultural Sciences and Rural Development, Medziphema Campus, Nagaland University, Nagaland during 2013 and 2014 to assess the effect of integrated nutrient management on yield and economics of turmeric. The experiments were laid out in Randomized Block Design (RBD) with three replications. Eighteen treatments (T_1- Control, T_2 - 100% RDF (80:60:60 kg NPK ha^{-1}), T_3 - FYM (40 t ha^{-1}), T_4 - Pig manure (30 t ha^{-1}), T_5 - Poultry manure (25 t ha^{-1}), T_6 - Vermicompost (10 t ha^{-1}), T_7 - FYM + biofertilizer, T_8 - Pig manure + biofertilizer, T_9 - Poultry manure + biofertilizer, T_{10}- Vermicompost + biofertilizer, T_{11}- 50% NPK + 50% FYM, T_{12}- 50% NPK + 50% Pig manure, T_{13}-50% NPK+ 50% Poultry manure, T_{14}- 50% NPK + 50 % Vermicompost, T_{15}- 50 % NPK + 50 % FYM + biofertilizer, T_{16}- 50 % NPK + 50 % Pig manure + biofertilizer, T_{17}- 50 % NPK + 50 % Poultry manure + biofertilizer, T_{18} - 50 % NPK + 50 % Vermicompost + biofertilizer) were included in the experiments. Results revealed that application of different levels of fertilizers, organic manures and biofertilizer either alone or in combination significantly increased fresh yield of turmeric as compared to control. The maximum fresh yield (48.06 tones ha^{-1}) was recorded with the combined application of 50% NPK + 50% Poultry manure + biofertilizer, which was closely followed by 50% NPK + 50% Vermicompost + biofertilizer (44.05 tones ha^{-1}). Highest net return (profit) of ₹ 3,66,410 along with cost benefit ratio of 1:3.20 was also recorded in the treatment of 50% NPK + 50% Poultry manure + biofertilizer

Keywords:

Turmeric, integrated nutrient management, yield and economics.

INTRODUCTION

Turmeric also known as the golden spice (*Curcuma longa* L.) belongs to family, Zingiberaceace. It is one of the most important and ancient spice of India. The processed and dried underground portion called 'rhizome' forms the basis of commerce which is use in culinary, medicinal, cosmetics and textile industries. It is rich in minerals, vitamins and besides that it contains 4-7 % curcumin. Curcumin ($C_{21}H_{22}O_6$) chemically diferumethane is the principal colouring pigment in turmeric. Turmeric is used as a stomachic, tonic and blood purifier, germicides, antiseptic and has anti-oxidant properties. Turmeric is third largest spice produced in country and contributed 20.34% of total spice produced in India. India is the largest producer, consumer and exporter of turmeric in the world that accounts about 80 per cent of the world's turmeric production. India produces turmeric about 1.19 million tonnes from an area of 0.233 million hectares with an average productivity of 5.10 tonnes/ha (Anon., 2014). India exported about 86,000 tonnes of turmeric with a value of ₹ 744.35 crores during 2014-2015 (Anon., 2015). The climatic condition of the North eastern region is quite conducive to commercial cultivation of turmeric. But inspite of the favourable agro-climatic conditions, production level is low due to lack of proper package of practices. Among various factors responsible for low production of turmeric, nutrition is of prime importance. Turmeric being a heavy feeder and exhaustive crop responds very well to nutrients application. The increasing use of chemical fertilizers to increase spice production has been widely recognized but its long run impact on soil health, ecology and other natural resources are detrimental which affect living organisms including human being. The escalating prices of chemical fertilizers and its detrimental impact on the soil health, environment and human health urged the farmer to adopt alternative source of nutrients for spice production. Therefore, to reduce dependency on chemical fertilizers and conserving the natural resources in align with sustainable vegetable production are vital issues in present time which is only possible through integrated plant nutrient supply system (Moakala *et al.* 2015). Besides fertilizers, there are several sources of plant nutrients like organic manures, biofertilizers etc. These nutrients sources apart from manuring of soil nutrients also improve overall soil productivity. Use of organic manures in INM help in mitigating multiple nutrient deficiencies. Application of organic manures to acidic soil reduces the soluble and

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exchangeable Al temporarily by forming complex and provides better environment for growth and development in addition to improvement in physical, chemical and biological properties of soil (Tekaasangla *et al.* 2015). Biofertilizers have also emerged promising components of nutrient supply system. Application of biofertilizers which is environment friendly and low cost input, with organic and inorganic fertilizers as part of an integrated nutrient management strategy and play significant role in plant nutrition. The role of biofertilizers is perceived as growth regulators besides biological nitrogen fixation collectively leading to much higher response on various growth and yield attributing characters (Avitoli *et al.* 2012). The diverse agro-climatic conditions, varied soil types and abundant rainfall under foothills condition of Nagaland enable the favorable cultivation of turmeric. But no information is available about the nutrient management of turmeric in North Eastern region including acidic soils of Nagaland in particular. In view of the above, the present investigation was conducted to study the effect of integrated nutrient management on the yield and economics of turmeric under foothills of Nagaland.

MATERIALS AND METHODS

The experiments were carried out in the Experimental Farm, Department of Horticulture, School of Agricultural Sciences and Rural Development, Medziphema Campus, Nagaland University, Nagaland, during 2013 and 2014. The field was located at the altitude of 304.8 m above mean sea level with geographical location at 20º 45' 43" N latitude and 93 º 53' 04" E longitudes. The experiments were laid out in Randomized Block Design with three replications. Plot size measured 2.0 m x 2.0 m and spacing was maintained at 30 x 30 cm. The treatments consisted of T_1- Control, T_2 - 100% RDF (80:60:60 kg NPK ha^{-1}), T_3 - FYM (40 t ha^{-1}), T_4 - Pig manure (30 t ha^{-1}), T_5 - Poultry manure (25 t ha^{-1}), T_6 - Vermicompost (10 t ha^{-1}), T_7 - FYM + biofertilizer, T_8 - Pig manure + biofertilizer, T_9 - Poultry manure + biofertilizer, T_{10}- Vermicompost + biofertilizer, T_{11}- 50% NPK + 50% FYM, T_{12}- 50% NPK + 50% Pig manure, T_{13}-50% NPK+ 50% Poultry manure, T_{14}- 50% NPK + 50 % Vermicompost, T_{15}- 50 % NPK + 50 % FYM + biofertilizer, T_{16}- 50 % NPK + 50 % Pig manure + biofertilizer, T_{17}- 50 % NPK + 50 % Poultry manure + biofertilizer, T_{18} - 50 % NPK + 50 % Vermicompost + biofertilizer. N, P and K were given through Urea, SSP and MOP respectively. Full dose of P and K and half dose of N were applied at the time of planting and remaining half dose of N was given in two equal doses *ie*. 45 and 90 days after planting. Manures viz., FYM, pig manure, poultry manure and vermicompost were incorporated as per treatment in respective plot 20 days prior to planting. Biofertilizer (*Azospirillum brasilense*) was inoculated to seed rhizome prior to planting @ 5 kg ha^{-1}. Data on fresh rhizome yield was recorded bioth the year and statistically analysed as per procedure given by Panse and Sukhatme (1989). Economics of the different treatments were also calculated as per prevailing market price of inputs and outputs. Gross income was calculated by fresh rhizome yield multiplied with whole sale rate of turmeric (₹ 10,000 $tones^{-1}$). Net income was estimated by deducting the total cost of cultivation (fixed cost + treatment cost) from gross income of the particular treatment. Cost-benefit ratio was worked out by dividing net return from total cost of cultivation.

RESULTS AND DISCUSSIONS

Integrated application of chemical fertilizers, organic manures and biofertilizer alone or in combination has appreciable effect in the altering of rhizome yield and economics of turmeric. It is revealed from the table-1 that integrated application of 50 % NPK + 50 % poultry manure + biofertilizer (T_{17}) recorded the highest rhizome yield of turmeric (48.06 tones ha^{-1}) which was closely followed by the treatment 50% NPK + 50% vermicompost + biofertilizer (T_{18}) where the rhizome yield recorded was 44.05 tones ha^{-1}. The treatment 50 % NPK + 50 % poultry manure + biofertilizer (T_{17}) recorded significantly higher rhizome yield over all the treatments except treatment 50% NPK + 50% vermicompost + biofertilizer (T_{17}). The treatment difference between treatment 50 % NPK + poultry manure + biofertilizer (T_{17}) and 50 % NPK + 50 % vermicompost + biofertilizers (T_{18}) was found statistically at par. This result indicates positive effects of integrating NPK with manures as well as biofertilizer. This may be due to favourable effect of integrated application of organic manure, biofertilizer and inorganic fertilizer in supplying all essential nutrients in balanced ratio and also improved the fertility status of soil. Also, biofertilizer or microbial inoculant might have played a vital role in increasing the rhizome yield. Another reason may be that added poultry manure/vermicompost in INM would have improved the physical, chemical and biological properties of soil which helps in better nutrients absorption and utilization by plant resulting higher rhizome yield. Results are inconformity with findings of Senapati (2005), Padmapriya *et al.* (2009), Singh (2011) and Nanda *et al.* (2012).

It is evident from table 1 that integration of 50 % NPK + 50 % poultry manure + biofertilizer (T_{17}) was found to be the most profitable treatment in turmeric exhibiting highest net return (profit) ₹ 3,66,410 along with cost benefit ratio of 1:3.20. The reason of high net economic return (profit) in the treatment of 50 % NPK + 50 % poultry manure + biofertilizers was due to low input cost and high rhizome yield. Lowest net return of ₹ 1,34,400 was obtained in the treatment of T_1 (Control). Similar results were also reported by Moakala *et al.* (2015) in broccoli, they found highest net return with combined application of 50 % NPK + 50 % poultry manure + biofertilizer.

CONCLUSION

Based on the present findings, it may be concluded that integrated application of 50 % NPK + 50 % poultry manure + biofertilizer is considered the best treatment for getting higher fresh rhizome yield and economics (profit) in turmeric under Nagaland conditions.

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Table 1: Effect of integrated nutrient management on yield and economics of turmeric (Pooled data of two years)

Treatments	Fresh rhizome yield ha^{-1} (tons)	Cost of cultivation (₹ ha^{-1}) Fixed cost	Treatment cost	Total Cost	Gross income (₹ ha^{-1})	Net income (₹ ha^{-1})	Cost benefit ratio
T_1 - Control	23.14	97000	-	97,000	231400	134400	1:1.38
T_2 - 100% NPK (80:60:60 kg ha^{-1})	33.85	97000	8980	105980	338500	232520	1:2.19
T_3 - FYM (40 t ha^{-1})	29.35	97000	20000	117000	293500	176500	1:1.51
T_4 - Pig manure (30 t ha^{-1})	29.94	97000	21000	118000	299400	181400	1:1.53
T_5 - Poultry manure (25 t ha^{-1})	30.60	97000	25000	122000	306000	184000	1:1.51
T_6 - Vermicompost (10 t ha^{-1})	30.29	97000	100000	197000	302900	105900	1:0.53
T_7 - FYM + Biofertilizer	30.65	97000	20200	117200	306500	189300	1:1.61
T_8 - Pig manure + Biofertilizer	31.05	97000	21200	118200	310500	192300	1:1.62
T_9 - Poultry manure + Biofertilizer	32.24	97000	25200	122200	322400	200200	1:1.63
T_{10}- Vermicompost + Biofertilizer	31.61	97000	100200	197200	316100	118900	1:0.60
% NPK + 50% FYM	35.05	97000	14490	111490	350500	239010	1:2.14
% NPK + 50% Pig manure	37.51	97000	14990	111990	375100	263110	1:2.34
% NPK+ 50% Poultry manure	39.39	97000	16990	113990	393900	279910	1:2.45
% NPK + 50 % Vermicompost	38.44	97000	54490	151490	384400	232910	1:1.53
% NPK + 50 % FYM + Biofertilizer	40.27	97000	14690	111690	402700	291010	1:2.60
% NPK + 50 % Pig manure + Biofertilizer	40.32	97000	15190	112190	403200	291010	1:2.59
% NPK + 50 % Poultry manure + Biofertilizer	48.06	97000	17190	114190	480600	366410	1: 3.20
% NPK + 50 % Vermicompost + Biofertilizer	44.05	97000	54690	151690	440500	288810	1:1.90
CD (P=0.05)	7.70						

FYM (0.5%N) - ₹ 500 tons^{-1}, Pig manure (0.75% N) - ₹ 700 tons^{-1}, Poultry manure (1.0 %N) - ₹ 1000 tons^{-1}, Vermicompost (1.5%N) - ₹ 10000 tons^{-1}

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