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Effect of fertilizers in combination with organic manure on the yield performance of turmeric

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Abstract: A field experiment was conducted at the farmer's field in Sherpur district under Regional Agricultural Research station, Bangladesh Agricultural Research Institute (BARI), Jamalpur, during Kharif season from 19 April 2008 to 25 February, 2009 and 19 April 2009 to 25 February 2010 to find out suitable combination of fertilizers and manure for maximizing the yield of turmeric. Seven packages of fertilizers in combination with manure (F_1 = Control, F_2 = Soil test base (STB): $N_{130}P_{40}K_{130}S_{15}Zn_2$, F_3 = 50%, STB + 5 ton cowdung/ha, F_4 = FRG-2005: $N_{120}P_{30}K_{100}S_{15}Zn_3$ kg/ha +3 ton cowdung/ha, F_5 = 75% FRG-2005+5 ton cowdung/ha, F_6 = 10 ton cowdung/ha, F_7 = Farmer's practice: $N_{50}P_{20}K_{40}$+ 5 ton cowdung/ha) were used in the experiment. A randomized complate block design was followed for the experiment. BARI halud-1 was used as the test crop. From the results of the experiment, it was found that among the treatments as expected F_3= 50% STB ($N_{65}P_{25}K_{70}S_{10}Zn_2$) +5 (ton cowdung/ha) is the highest yield of termaric in the both year (22.01 t/ha and 22.11 t/ha) with the highest BCR (10.67 and 10.72) and lowest yield (8.00 t/ha, 8.01t/ha) with BCR (3.65 and 3.65) was obtained when the plants raised with control treatment.
Key words: Effect, Fertilizers, Organic manure, Combination Yield, Turmeric.

Introduction

Turmeric (*Curcuma longa*) is a rhizomatous herbaceous perennial plant of the ginger family, Zingiberaceae. It is native to tropical South Asia and needs temperatures between 20°C and 30°C, and a considerable amount of annual rainfall to thrive. Plants are gathered annually for their rhizomes, and reseeded from some of those rhizomes in the following season. In medieval Europe, turmeric became known as Indian saffron, since it was widely used as an alternative to the far more expensive saffron spice.

Although usually used in its dried, powdered form, turmeric is also used fresh, much like ginger. It has numerous uses in Far Eastern recipes, such as fresh turmeric pickle, which contains large chunks of soft turmeric.

Turmeric (coded as E100 when used as a food additive)[5] is used to protect food products from sunlight. The oleoresin is used for oil-containing products. The curcumin/ solution or curcumin powder dissolved in alcohol is used for water-containing products. Over-coloring, such as in pickles relishes, and mustard, is sometimes used to compensate for fading.

Turmeric is widely used as a spice in South Asian and Middle Eastern cooking. Many Persian dishes use turmeric for the coloring of rice bottoms, as well as a starter ingredient for almost all Iranian fry ups (which typically consist of oil, onions and turmeric followed by any other ingredients that are to be included). In Nepal, turmeric is widely grown and is extensively used in almost every vegetable and meat dish in the country for its color, as well as for its medicinal value. In South Africa, turmeric is traditionally used to give boiled white rice a golden color

The turmeric (*curcuma longa*) is an important and common spice crop of Bangladesh. Among the spices crops turmeric is a popular and is used in huge numbers of food items. Besides this, it is used in preparing cosmetics and is a raw material of dyeing industries. It has also medicinal values. In Bangladesh, its average yield at the farmer's level is 2.26 t/ha (dry). Its annual production is 41500 tons which is much less than the demand (BBS, 2006). Turmeric can be grown in variety of soil but it prefers to grow in light textured soil and well-suited shady places. Reasons behind this lower yield are lack of high yielding varieties, improved production technology and proper use of fertilizers and manures. Rao and Swamy (1984) had reported favorable response of NPK fertilization in quality of turmeric.

Crops respond differently to different fertilizer elements, and proper fertilizer management for a plant species is important for increasing yield and quality. Nitrogen (N), phosphorus (P) and potassium (K) are the three major nutrients, which individually and/or together maintain growth, yield and quality of plants (Mazid, 1993). N is involved in chlorophyll formation, and it influences stomatal conductance and photosynthetic efficiency (Mazid, 1993). N is responsible for 26-41% of crop yields, K plays catalytic roles in the plant rather than becoming an integral part of plant components. It regulates the permeability of cell walls and activities of various mineral elements as well as neutralizing physiologically important organic acids. Plants with an inadequate supply of K show poor fruit or seed formation, yellowing of the leaves, poor growth, and low resistance to coldness and drought. A sufficient supply of K promotes N uptake efficiency of plants due to its stimulant effect on plant growth. P indirecdy promotes plant growth and absorption of K as well as odier nutrients. Hence, the present study was undertaken to find out the optimum rates of fertilizers and manures for higher yield of turmeric.

Materials and Methods

The Experiment was conducted at farmer's field in Sherpur district under Regional Agricultural Research station, Bangladesh Agricultural Research Institute (BARI), Jamalpur, during Kharif season from April 2008 to February, 2009 and April 2009 to February 2010. The initial soil samples collected from a depth of 0-15 cm were analyzed by ASI method (Hunter, 1984) and the properties are presented in Table 1.

The unit plot size was 2.0m X 2.0m and spacing maintained for Termaric 50cm apart with plant to plant distance 25 cm. The treatments comprising of F_1 = (control), F_2 = (Soil test base: $N_{130}P_{40}K_{130}S_{15}Zn_2$ kg/ha), F_3 = (50% STB + 10 ton cowdung/ha), F_4 = (FRG -2005: $N_{120}P_{30}K_{100}S_{15}Zn_3$ kg/ha + 3 ton cowdung/ha), F_5 = (75% FRG-2005+5 ton cowdung/ha), F_6 = (10 ton cowdung/ha) and F_7 = (Farmer's practice: $N_{50}P_{20}K_{40}$+5 ton cowdung/ha) were the experiment laid out in randomized block design with three replications. Full dose of cowdung, PKS and Zn were applied at final land preparation and half of N dose was applied at 50 days after planting. Remaining N were applied in two equal splits at 80 and 110 days after planting. Rhizomes (BARI halud-1) were planted 12 April, 2008 and 2009. Different intercultural operations such as pest and disease management, weeding, irrigation, earthing up etc. were done as and when necessary. Rhizomes were harvested 10 February, 2009 and 2010 when plant showed symptoms to leaf drying and lodged on the soil.

Table 1. Initial Soil nutrient status of experiment plot

Location	PH	OM	Total N	K	P	S	Zn
		%	%	Meq/100g	µg/g		
Sherpur Sadar	5.8	0.90	0.11	0.13	15	12	0.33
Critical level	-	-	-	0.2	14	14	2.0

Data on plant height, No. of plant/hill, No. of leaves/plant, No. of primary finger/hill, rhizome wt/plot and rhizome yield t/ha were recorded from randomly selected 10 plants of each treatment. The data were analyzed statistically and means were separated to find out difference among the treatments.The Recorded data were compiled and analyzed statistically and means were separated by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984). To find out the difference among the treatments benefit cost ratio (BCR) of different treatments were also calculated.

Results and Discussion

Data regarding the effects of different combinations of fertilizers and organic manure showed significant variation on the growth and yield components of turmeric namely plant height, No. of plant/hill, No. of leaves/hill, No of primary finger/hill and rhizome yield in 2008-2009 (Table 2). The highest plant height (105.0 cm), No. of plant/hill (7.23), No. of leaves/hill (10.17), No. of primary fingers/hill (9.71) was obtained from the use of 50% STB with 5 t CD/ha (F_3). It was followed by the performance of FRG dose (F4), 75% FRG dose+5 t CD/ha, farmer's practice (F_7) and then 10 t CD/ha (F_6). The values of all parameters were found lowest in control treatment (F_1). Rhizome yield/plot (kg) (8.74 kg/plot) and Rhizome yield (22.01 t/ha) were observed maximum in the plot raised with F_3 and control treatment F_1 gave the minimum. Application of 5 t CD/ha might increase the physical properties of soil which was again enhanced by the use of 50% STB resulting the increased growth and yield of turmeric. It is also revealed from the experiment that only chemical fertilizer could not supply the proper soil environment for yield maximization of turmeric. The combined application of chemical and organic fertilizer is effective for higher yield of turmeric. N applied alone or in combination with P, K or PK resulted in a significantly higher plant height, and number of leaves and tillers. N is the principal nutrient of plant, which significantly increases vegetative growth parameters of turmeric than any other nutrients (Mazid, 1993). Turmeric plants grown with P or K did not show improvement in any vegetative growth parameters.

The highest yield was obtained from the turmeric grown with NPK followed by NK , because the plants with these treatments remained green longer and they had higher shoot biomass, which ultimately contributed to higher yield (Hikaru *et al.* 2007).

The highest BCR (10.67) was obtained from F_3 = 50%, STB + 5t CD/ha treated plot followed by F_4 = FRG-2005: $N_{120}P_{40}K_{120}S_{15}Zn_3$ (8.55), F_5 = 75% FRG-2005+5 t CD/ha(8.18), F_7 = Farmer's practice: $N_{60}P_{30}K_{60}$+ 5 t CD(8.07), F_6 = 10 t CD/ha(7.75), F_2 = Soil test base (STB): $N_{130}P_{40}K_{130}S_{15}Zn_2$ (7.27) and lowest was (3.65) obtained from control treated plot F_1 (Table 3).

Table 2. Growth and yield components of turmeric as influenced by different fertilizers and organic manure level.2008-2009

Treatment	Plant height (cm)	No. of plant/hill	No. of leaves/plant	No. of primary finger/hill	Rhizome yield/plot (kg)	Rhizome yield (t/ha)
F1	70.17 b	2.54 c	4.15 c	4.18 c	3.20 c	8.00 c
F2	87.3 b	3.72 bc	7.20 ab	6.75 b	6.40 b	16.02 b
F3	105.0 a	7.23 a	10.17 a	9.71 a	8.74 a	22.01 a
F4	98.0 a	5.27 ab	9.00 a	8.05 ab	7.30 ab	18.40 ab
F5	101.4 a	5.10 ab	10.00 a	8.04 ab	7.11 ab	17.77 ab
F6	95.0a	4.09 bc	7.11 ab	7.00 b	6.34 b	16.10 b
F7	97.0 a	5.06 ab	8.20 a	7.28 b	6.70 ab	17.00 ab
CV (%)	10.4	16.9	20.5	15.3	16.0	16.18
Level of sig.	**	**	**	**	**	**

** Significant of 1% level of significance, F_1 = Control, F_2 = Soil test base (STB): $N_{130}P_{40}K_{130}S_{15}Zn_2$, F_3 = 50%, STB + 5t CD/ha, F_4 = FRG-2005: $N_{120}P_{30}K_{100}S_{15}Zn_3$, F_5 = 75% FRG-2005+5 t CD/ha, F_6 = 10 t CD/ha, F_7 = Farmer's practice: $N_{50}P_{20}K_{40}$+ 5 t CD/ha

Table 3. Economics analysis of different treatment at Sherpur district under RARS Jamalpur during 2008-2009

Treatment	Yield (kg/ha)	Variable cost Tk	Gross return (Tk/ha))	Net return (Tk/ha))	BCR
F_1	8.01	85966	400500	314534	3.65
F_2	16.02	96852	801000	704148	7.27
F_3	22.01	94292	1100500	1006208	10.67
F_4	18.40	96357	920000	823643	8.55
F_5	17.77	96759	888500	791741	8.18
F_6	16.10	91966	805000	713034	7.75
F_7	17.00	93668	850000	756332	8.07

BCR= Net return / Variable cost, Price of turmeric rhizome =50 Tk./kg, Cost of urea=12 Tk./kg, Cost of MP=15 Tk./kg, Cost of TSP = 22 Tk./Kg, Cost of Gypsum=8 Tk./kg , Cost of B=200 Tk./kg, Cost of Zn=80 Tk./kg, Cost of Insecticide = 1000 Tk. required for 1 ha of crop field, Cost of labour=140Tk./labour day. 595 labours being required for 1hectare of crop field. Other variable costs were same in all the treatment.

Table 4. Growth and yield components of turmeric as influenced by different fertilizers and organic manure level during 2009-2010

Treatment	Plant height (cm)	No. of plant/hill	No. of leaves/plant	No. of primary finger/hill	Rhizome yield/plant (kg)	Rhizome yield (t/ha)
F1	70.17 b	2.54 c	4.15 c	4.18 c	3.20 c	8.01 c
F2	87.6 b	3.92 bc	7.30 ab	6.95 b	6.50 b	16.24 b
F3	105.1 a	7.33 a	10.27 a	9.91 a	8.84 a	22.11 a
F4	98.0 a	5.57 ab	9.00 a	8.15 ab	7.40 ab	18.50 ab
F5	101.6 a	5.20 ab	10.11 a	8.04 ab	7.11 ab	17.97 ab
F6	95.2 a	4.19 bc	7.21 ab	7.00 b	6.44 b	16.10 b
F7	97.1 a	5.06 ab	8.40 a	7.38 b	6.80 ab	17.00 ab
CV (%)	10.4	16.9	20.5	15.3	16.0	16.18
Level of sig.	**	**	**	**	**	**

** Significant of 1% level of significance, F_1 = Control, F_2 = Soil test base (STB): $N_{130}P_{40}K_{130}S_{15}Zn_2$, F_3 = 50%, STB + 5t CD/ha, F_4 = FRG-2005: $N_{120}P_{30}K_{100}S_{15}Zn_3$, F_5 = 75% FRG-2005+5 t CD/ha, F_6 = 10 t CD/ha, F_7 = Farmer's practice: $N_{50}P_{20}K_{40}$+ 5 t CD/ha.

Table 5. Economics analysis of different treatment at Sherpur district under RARS Jamalpur during 2009-2010

Treatment	Yield (kg/ha)	Variable cost Tk	Gross return (Tk/ha)	Net return (Tk/ha)	BCR
F_1	8.01	85966	400500	314534	3.65
F_2	16.24	96852	812000	715148	7.38
F_3	22.11	94292	1105500	1011208	10.72
F_4	18.50	96357	925000	828643	8.60
F_5	17.97	96759	898500	801741	8.28
F_6	16.10	91966	805000	713034	7.75
F_7	17.00	93668	850000	756332	8.07

BCR= Net return / Variable cost, Price of turmeric rhizome =50 Tk./kg, Cost of urea=12 Tk./kg, Cost of MP=15 Tk./kg, Cost of TSP = 22 Tk./Kg, Cost of Gypsum=8 Tk./kg , Cost of B=200 Tk./kg, Cost of Zn=80 Tk./kg, Cost of Insecticide = 1000 Tk. required for 1hectare of crop field, Cost of labour=140Tk./labour day. 595 labours being required for 1hectare of crop field. Other variable costs were same in all the treatment.

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From two years study, it can be concluded that 50% STB+5tCD /ha i.e $N_{65}P_{25}K_{70}S_{10}Zn_2$ kg/ha +5 t cowdung/ha is the suitable combination of fertilizers and manure for higher yield and economically profitable.

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