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FERTILIZER REQUIREMENT FOR OKRA- FALLOW- T. AMAN CROP SEQUENCE IN COASTAL SALINE AREAS OF BANGLADESH

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Abstract

Fertilizer dose for Okra- Fallow-T. Aman cropping sequence was determined experimentally in the saline soils of the coastal regions of Bangladesh. Application of 25% more N, P and K fertilizers with 100% STB ($N_{68.5}P_{32.2}K_{8.9}Zn_{2\ kg/ha}$ for Okra and $N_{68.5}P_{15}K_{9.7}Zn_{1.5kg/ha}$ for T. Aman) increased fruit/plant, fruit length (cm) and individual fruit weight of okra, and effective tillers/hill, panicle length, filled/panicle and 1000-grain weight of BRRI dhan30. As a result the highest fruit of okra (12.89 t/ha) and grain yield of BRRI dhan30 (5.06 t/ha) were obtained from this treatment. Therefore, 25% increase of N, P and K fertilizers of STB fertilizer doses might be recommended for okra - Fallow-T. Aman cropping sequence in saline areas of coastal belt.

Agriculture is a major economy sector of Bangladesh and the coastal zone of Bangladesh, an area covering 19 districts accounts for 30% of the cultivable land and 28% of the population, has a great potential for agricultural production (Islam and Mohiuddin 2004). But the agriculture of coastal belt is vulnerable because of several climatic and natural constraints (SRDI 2009). Due to unfavorable soil, water and climatic condition farmers mostly cultivate low yielding, traditional rice varieties during wet season and most of the land remains fallow in the dry season (January-May) because of soil salinity, lack of good quality irrigation water and late draining condition (Karim *et al.* 1990, Mondal 1997, SRDI 2001). For reducing the adverse affects of salts several new and suitable cropping patterns like okra - Fallow-T. Aman , sweetgourd - Fallow-T. Aman , Sesame - Fallow-T. Aman and maize - Fallow-T. Aman etc. have been developed for coastal belt increasing cropping intensity in recent ages.

Fertilizer recommendation guide (FRG 2012) has provided soil test based (STB) fertilizer doses of the mentioned varieties and cropping patterns generated through soil test-crop response studies. But often STB fertilizer doses cannot produce the optimum yield of the respective crops in different saline areas due to high salt concentration, because salinity imposes ionic toxicity to plants, leading to nutrition disorder. Plant growth in these soils is adversely affected because of reduced water uptake, salt toxicity, and nutrient imbalances (Munns *et al.* 2006). A slight increase of fertilizer doses may result optimum yields was explained by several scientists (Ali *et al*. 2013). Beneficial effort of higher doses of fertilization with N, P and K has been reported in potato, tomato, brinjal and okra under saline soils (SRDI 2009). Considering the above points the present study was undertaken to verify and update the existing soil test based fertilizer recommendation of okra- Fallow - T. Aman cropping sequence.

The experiment was set up at the farmer's field of Ghagramari village under Batiaghata Upazila of Khulna district (GPS coordinate: N-22°41´36.6˝, E-89°31´52.4˝). Initial soil sample were collected from the experimental field from 0 - 15 cm depth and was analyzed. EC and pH of

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the soil samples were determined from 1 : 1 and 1 : 2.5 soil-water extract, respectively by glass-electrode method (Jackson 1962, Andersoen and Ingram 1966). Total N was determined by Micro-kjeldahl distillation method (Bremner and Mulvany 1982), available P by revised Olsen method (Olsen *et al.* 1954, Olsen and Sommers 1982), %OM by wet oxidation method (Walkley and Black 1934), available S by calcium biphosphate extraction method (Fox *et al.*1964), available Zn by DTPA extraction method (Lindsay *et al.* 1978), exchangeable K by ammonium acetate extraction method (Coleman *et al.* 1959, Knudsen *et al.* 1982), soil texture according to USDA system by hydrometer method (Day 1965) for determining physical and chemical properties for assessing soil fertility and soil test based (STB) fertilizer recommendation (Table 1).

Table 1. Properties of initial soil of the experimental field at Ghagramari village under Batiaghata Upazilla of Khulna district.

Textural class	pH	EC (dS/m)	OM (%)	Total N (%)	P (ppm)	K(meq/ 100 g/ soil)	S (ppm)	Zn (ppm)	B (ppm)
Clay Loam	7.7 Slightly alkaline	13.50 Moderately saline	2.67 Medium	0.155 Low	5.99 Low	0.38 High	158.70 Very high	0.73 Optimum	0.68 Optimum

Seeds of okra (Hybrid komol) and BRRI dhan30 (T. Aman) were collected from BARI and BRRI, respectively to use as the test crop. The land was prepared thoroughly by ploughing and cross ploughing with a power tiller. After uniform leveling, the experiment was laid out in a RCBD. The size of each unit plot was 4 m × 2.5 m and plots were separated from each other by drains (0.5 m).

For okra cultivation during Kharif-1 season P, K, S and Zn fertilizers were applied to the individual plots during final land preparation according to the treatments. The treatments were T_1 = 100% of soil test based (STB) fertilizers ($N_{68.5}P_{32.2}K_{8.9}Zn_{2\ kg/ha}$ for Okra and $N_{68.5}P_{15}K_{9.7}Zn_{1.5kg/ha}$ for T. Aman), $T_2 = T_1$ + 25% N of STB, $T_3 = T_1$ + 25% NP of STB, $T_4 = T_1$ + 25% NK of STB, $T_5 = T_1$ + 25% PK of STB $T_6 = T_1$ + 25% NPK of STB, T_7 = 75% of STB, and T_8 = Control. Urea was applied in four equal splits: first split was applied at 15 days after sowing (DAS), second split of urea was applied at 35 DAS (flowering stage), third split was applied at 45 DAS (fruiting stage) and fourth split was applied at 60 DAS. Healthy seeds of okra were line-sowed in the experimental plots with spacing 60 × 50 cm. Intercultural operations like irrigation, weeding, earthening up and insect and pest control were done as and when necessary following standard procedures. The edible fruits were harvested from the experimental plots at every alternate day. Five plants were randomly selected from each plot to record the yield contributing characters like, number of fruit/plant, fruit length and individual fruit weight (g).

After harvesting of okra, the experimental plots were kept fallow for about three months. Then they were prepared for transplanting seedlings of BRRI dhan30 during Kharif-2 season. The experimental plots were prepared thoroughly by puddling and cross puddling with a spade. Except urea, other fertilizers were applied to the individual plots during final land preparation according to the treatments used. Urea was applied in three equal splits (at 15, 30 and 50 days after transplanting). Thirty days old healthy seedlings of BRRI dhan30 were transplanted with spacing of transplanting 20 cm × 20 cm, and three seedlings were transplanted in each hill. Intercultural operations like irrigation, weeding and insect and pest control were done as and when necessary following standard procedures. The crop was harvested at full maturity and the harvested crop of each plot was bundled separately. Five hills were randomly selected from each plot at maturity to record the yield contributing characters like, number of effective tiller/hill, panicle length, number

of filled grain/panicle and weight of 1000-grain. After threshing of the crop, grain and straw from each unit plot was sun dried and weighed. The results were expressed as t/ha on 14% moisture basis. The analysis of variance for various yields and yield attributes were done following the F-test. Mean comparisons of the treatments were made by the DMRT.

Addition of 25% increased amount of N, P, K chemical fertilizers alone or in different combinations over 100% STB resulted an increase in number of fruits/plant, fruit length and individual fruit, while a decrease of chemical fertilizers (75% STB) resulted a decrease of these parameter (Table 2). The highest number of fruits/plant (14.93) fruit length (5.04cm) and individual fruit weight (25.90 g) were found in the treatment T_6 (T_1 + 25% NPK) was at par with treatment T_2 T_3 T_4 and T_5, respectively. All the treatments from T_1 to T_7 produced significantly higher number of fruits/plant, fruit length and individual fruit over T_8 (control) treatment which produced the lowest fruits/plant plant (9.77), fruit length (3.21 cm) and individual fruit weight (18.85 g).

Table 2. Effect of different fertilizers combinations on the yield contributing characters and yield of okra (Hybrid komol).

Treatment	Fruit/plant (No.)	Fruit length (cm)	Individual fruit weight (gm)	Fruit yield (t/ha)
T_1	13.61b	4.57ab	24.05ab	10.91c
T_2	14.29ab	4.87a	24.31ab	11.58b
T_3	14.09ab	4.95a	24.93ab	11.71b
T_4	14.47ab	4.99a	25.09ab	12.10b
T_5	13.99ab	4.94a	25.30ab	11.80b
T_6	14.93a	5.04a	25.90a	12.89a
T_7	13.37bc	4.11b	23.37bc	9.65d
T_8	9.77d	3.21c	18.85c	6.57e
CV (%)	4.12	4.46	4.70	4.16

*In a vertical column, means followed by the same letter are not significantly different.

Fruit yields due to different treatments varied from 6.57 to 12.89 t/ha (Table 2). The highest fruit yield 12.89 t/ha was found in the treatment T_6 (T_1 + 25%NPK) was significantly higher from all other treatments. The second highest fruit yield 12.10 t/ha was found in the treatment T_4 was at par with 11.58, 11.71 and 11.80 t/ha recorded in T_2, T_3 and T_5 treatments, respectively. Rain and Lal (1999) and Gowda and Bharme (2002) reported similar fruit yield and yield contributing parameters of okra by applying different levels of N, P and K chemical fertilizers.

In case of BRRI dhan30, the number of effective tillers/hill, panicle length, number of filled grains/panicle and 1000-grain weight due to different treatments varied from 7.67 to 16.33, 18.44 to 24.39 cm, 84.17 to 133.32 and 20.61 to 24.17 g, respectively (Table 3). The highest number of effective tillers/hill (16.33), panicle length (24.39 cm), number of filled grains/panicle (133.32) and 1000-grain weight (24.17 g) was found in the treatment T_6 (T_1 + 25% NPK). Addition of 25% increased amount of N, P, K chemical fertilizers alone or in different combinations over 100% STB resulted an increase in effective tillers/hill, panicle length, number of filled grains/panicle and 1000-grain weight, but decrease of chemical fertilizers (75% STB) resulted a significant decrease. All the treatments from T_1 to T_7 significantly increased the number of effective tillers/hill, panicle length, number of filled grains/panicle and 1000-grain weight effective tillers/hill over T_8 (control) treatment which produced the lowest number of effective tillers/hill (7.67), panicle length (18.44 cm), number of filled grains/panicle (84.17) and 1000-grain weight (20.61 g).

Similar results of effective tillers/hill, panicle length and filled grains/panicle were also obtained by Mondal *et al.* (1990) and Halder *et al.* (2000).

Table 3. Effect of different fertilizer combinations on the yield contributing characters and yield of BRRI dhan30.

Treatment	Tillers/ hill (no.)	Panicle length (cm)	Filled grains/ panicle	1000-grain weight (gm)	Grain yield (t/ha)	Straw yield (t/ha)
T_1	14.00c	22.80b	115.98b	23.09ab	4.36b	5.32ab
T_2	16.00ab	22.75b	122.64ab	23.46ab	4.93a	5.50ab
T_3	15.00bc	23.63ab	119.17ab	23.18ab	4.96a	5.75a
T_4	15.33b	24.38a	131.65a	23.30ab	4.98a	5.95a
T_5	15.00bc	22.60b	119.95ab	23.47ab	4.48b	5.38ab
T_6	16.33a	24.39a	133.32a	24.17a	5.06a	6.08a
T_7	12.67d	22.50b	111.14c	22.95b	3.58c	4.87b
T_8	7.67e	18.44c	84.17d	20.61c	2.56d	3.40c
CV (%)	5.14	3.72	6.73	2.41	3.81	6.22

*In a vertical column, means followed by the same letter are not significantly different.

The grain and straw yields of BRRI dhan30 due to various treatments ranged from 2.56 to 5.06 and 3.40 to 6.08 t/ha, respectively (Table 3). The highest grain (5.06 t/ha) and straw (6.08 t/ha) yield was found in the treatment T_6 which was at par with treatments T_2, T_3 and T_4, respectively. Addition of 25% increased amount of N, P and K fertilizers alone or in different combinations over 100% STB resulted an increase in grain and straw yield. All the treatments from T_1 to T_7 significantly increased the grain and straw yield over control treatment which produced the lowest grain (2.56 t/ha) and straw (36.40 t/ha). These types of findings of 1000-grain weight, grain and straw yield were also reported by Chaudhary *et al.* (2011). Similarly Ali *et al.* (2013) observed that the application of recommended dose (RD) + 25% NPK of RD gave the highest yield of grain and straw of rice.

Considering yield and yield contributing parameters greatest performance was shown by T_6 (T_1 + 25% NPK) treatment in both the crop which resulted 18% fruit yield increase of okra and 16% grain yield increase of BRRI dhan30 over 100% STB fertilizers. As a result 25% increased dose of N, P and K fertilizers of soil test based recommended fertilizer doses i.e. $N_{86}P_{40}K_{11}Zn_{2kg/ha}$ for T. Aman (BRRI dhan30) and $N_{85}P_{19}K_{12}Zn_{1.5kg/ha}$ for okra (Hybrid komol) can be suggested for okra- Fallow- T. Aman cropping pattern in saline soils of coastal region. Verification and updating the existing soil test based fertilizer recommendation of different cropping is needed in other saline affected districts also.

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