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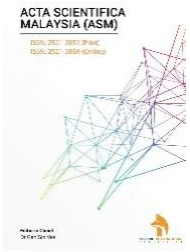

RESEARCH ARTICLE

INFLUENCE OF BANANA LEAVES IN ASSOCIATION WITH INORGANIC POTASSIUM FERTILIZER ON THE NUTRIENT CONTENT AND UPTAKE OF BRRI DHAN49

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ABSTRACT

An experiment was done at the Soil Science Department, Bangladesh Agricultural University (BAU) to study the joined use of banana leaves with inorganic potassium fertilizer on the development and yield of BRRI dhan49 placing Randomized Complete Block Design (RCBD) with eight treatments and three replications. The treatments were T_1: control (no fertilizer), T_2: RFD (Recommended Fertilizer Dose), T_3: (50% K from banana leaves+50% K from MoP) , T_4: (60% K from banana leaves+40% K from MoP), T_5: (70% K from banana leaves+30% K from MoP), T_6: (80% K from banana leaves+20% K from MoP), T_7: (90% K from banana leaves+10% K from MoP), T_8: (100% K from banana leaves).The uppermost potassium content in grain (0.33%) and straw (1.30%) were gained in the treatment T_3 and T_4 .The bottommost potassium content in grain (0.26%) and straw (1.08%) were logged in the control. At the same time, the highest potassium uptake by grain (19.46 kg ha^{-1}) and straw (89.06 kg ha^{-1}) were attained in the treatment T_3 and the lowest potassium uptake by grain (8.67 kg ha^{-1}) and straw (51.40 kg ha^{-1}) were documented in the control. Total (grain+straw) peak (108.52 kg ha^{-1}) potassium uptake was found in T_3 treatment and lowest (60.06 kg ha^{-1}) was found in control. It can be endorsed to cohesive use of 50% K from banana leaves+50% K from MoP on nutrient content and uptake of BRRI dhan49.

KEYWORDS

nutrient content, nutrient uptake, banana leaves, potassium fertilizer, grain, straw, BRRI dhan49.

1. INTRODUCTION

Bangladesh is an agrarian country and rice is the key food crop for the people of Bangladesh. Usage of organic manures viz. banana plant residues not only act as a source of K but also supply N to the crop. Cropping pattern is mostly rice based because in about 75.3% of the total cropped area and it elements more than 80% of the total irrigated area. The main provider of plant nutrients is soil. It has been using chemical fertilizers year after year for higher yield. Nitrogen, phosphorus and potassium are three foremost elements which are often applied through chemical fertilizers. As a result, our soil is losing their bearing volume for higher yield.

Integrated use of organic manures and chemical NPK fertilizers would be quite auspicious in providing greater steadiness in production and keeping higher soil fertility grade (Nambiar, 1991).

Among all the indispensable nutrients, potassium is engrossed in maximum amount by modern improved crop cultivars (Fageria et al., 1990). Banana is a temperately rapid growing, high potassium fixing and biomass producing plant. Generally annual potassium rich crops like banana is used as green manure throughout the world. It is very common in Bangladesh and its leaves comprise considerable amounts of K and other nutrients also. Litter of banana leaf contain 3.55% K (Shymum, 2006). Grain yield and K acceptance were the uppermost with 90 kg K_2O in all soils (Ghosh et al., 1994). They also originated that the present influence of soil K reduced significantly with increasing K fertilizer application. Increasing rate of potassium to a rice crop at the time of sowing specified that grains yields, K uptake and soil available K content were increased (Roy and Mathur, 1989).

Increasing rate of K_2O application increased plant K concentration and uptake (Pandey et al., 1993). On the other hand, perceived that N, P and K uptake were genuine by potassium application (Uapdhyay, 1995). Trivedi and Verma detected that grain yield and content of carbohydrate and protein were highest with N + K_2SO_4 + Mo (Trivedi and Verma, 1996). A group researcher reported that increasing the application level of fertilizers augmented the amount of nutrient uptake (Doikova et al., 1994). Some researchers suggested that application of K increased soil K availability, K contents in grain and straw (Krishnappa et al., 1990).

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Chokravarti stated that K application tended to increase grain N content and total N uptake by the crop, while P content was little affected (Chokravarti, 1989). Gradually higher content and uptake of K caused from increasing levels of K supply. Therefore, the present inquiry was assumed to study the effect of joined use of banana leaves with inorganic fertilizer on nutrient content and uptake by BRRI dhan49.

2. Materials and Methods

2.1 Experimental site and soil

The experiment was run at the Soil Science Field laboratory of Bangladesh Agricultural University. The soil goes to the AEZ 9 (Old Brahrnaputra Floodplain).

Table 1: Taxonomical characteristics of Soil

Order	Inceptisol
Sub-order	Aquept
Sub-group	Aerie Haplaquept
Soil series	Sonatala

Table 2: Morphological characteristics of Soil

Morphology	Characteristics
Location	Soil Science Field Laboratory, Bangladesh Agricultural University, Mymensingh
AEZ	Old Brahmaputra Flood plain
Land type	Medium high
General soil type	Non-calcarieous Dark Grey Flood plain
Parent material	Old Brahmaputra river borne deposits
Topography	Fairly level
Drainage	Moderately well drained
Flood level	Above flood level
Vegetation	Rice crop grown year round

Source: Detailed Soil Survey, BAU Farm, Mymensingh, 1978.

2.2 Climate

Monthly record of air temperature, rainfall, relative humidity and sunshine hours of BAU Soil Science farm during the whole experimental period (August -December, 2014) have shown in Table 2.

Table 2: Weather data regarding monthly average air temperature, rainfall, relative humidity and sunshine hours day^{-1} at the experimental site during the experimental period (August - December, 2014)

Month	Air temperature (°C)			Rainfall (mm)	Relative humidity (%)	Sunshine (hours day^{-1})
	Max.	Min.	Mean			
August	31.4	26.3	29.7	317.4	85.7	3.7
September	32.4	26.3	29.4	171.6	85.0	4.4
October	31.8	23.2	27.5	15.3	83.6	7.15
November	29.9	18.1	23.4	0.0	82.8	6.23
December	23.9	13.6	19.1	0.0	86.7	3.99

Source: Weather Yard, Department of Irrigation and Water Management, Records of Climatological Observations (Monthly), Bangladesh Agricultural University, Mymensingh.

2.3 Land preparation

The land was organized as to prerequisite of BRRI dhan49 farming.

2.4 Rice crop (BRRI dhan49)

BRRI dhan49 was taken as a test crop in this experiment. The regular grain yield of the variety usually lies between 5 to 5.5 t ha^{-1}. This variety is somewhat resilient to pests and diseases particularly stem rot, sheath blight and leaf blight. The seedlings were collected from Soil Science Farm, Bangladesh Agricultural University, Mymensingh.

2.5 Layout of the experiment

The experiment was placed in a Randomized Complete Block Design (RCBD) with 3 replications.

2.6 Treatments

There were 8 treatments out of which one was fully recommended dose of fertilizers. The treatment groupings used for the experiment were as follows:

1. T_1 = Control (No fertilizer)
2. T_2 = 100% Recommended Fertilizer Dose
3. T_3 = 50% K from banana leaves + 50% K from MoP
4. T_4 = 60% K from banana leaves + 40% K from MoP
5. T_5 = 70% K from banana leaves + 30% K from MoP
6. T_6 = 80% K from banana leaves+ 20% K from MoP
7. T_7 = 90% K from banana leaves +10% K from MoP
8. T_8= 100% K from banana leaves

2.7 Manures and Fertilizer application

Air dried Banana leaves were united @ 30 kg ha^{-1} (equivalent 50% K), 36 kg ha^{-1} (equivalent 60% K), 42 kg ha^{-1} (equivalent 70% K) 48 kg ha^{-1} (equivalent 80% K), 54 kg ha^{-1} 90% K) 60 kg ha^{-1} as per treatments at 15 days before transplanting of the rice seedlings. The banana leaves were mixed thoroughly with the soil. Suggested nitrogen @ 100 kg ha^{-1} from urea was applied in three equal split as per treatment. The first dose of urea was applied at 15 days after transplanting. The remaining doses of urea were top dressed at 32 days (active tillering stage) and 56 days (panicle initiation stage) after transplanting. P, K and S were applied @ 20, 60, and 12 kg ha^{-1} from triple superphosphate, muriate of potash, and gypsum individually in all the plots except control as basal dose. The amount of N, P and K content in banana leaves also abridged from the endorsed N, P and K fertilizer dose applied to the soil. Sources and rate of nutrients and chemical fertilizers for rice (BRRI dhan49) is offered in Table 1. Chemical compositions of the banana leaf litter used is presented in Table 2.

Table 1: Sources and rate of nutrients and chemical fertilizers for rice (BRRI dhan49)

Nutrients name nutrient	Rate (kg ha^{-1})	Source	Fertilizers (kg ha^{-1}) (kg/ ha)
N	100	Urea	217
P	20	TSP	95
K	60	MoP	120
S	12	Gypsum	66

Table 2: Nutrient contents in organic residues

Name of residue	Nutrient contents (%)		
	N	P	K
Banana leaf litter	3.4	0.22	3.55

2.8 Transplanting of rice seedlings

The seedling of BRRI dhan49 was transplanted on 23rd August, 2014 upholding plant spacing of 20cmx20cm. Three healthy seedlings were relocated in each hill.

2.9 Intercultural operations

Intercultural processes like irrigation, weeding, insect and pest control were done for ensuring and maintaining the normal growth of the crop.

2.10 Harvesting

The crop was reaped at full maturity on December 7, 2014. The harvested crop of each plot was hustled distinctly and transported to the threshing floor. Grain and straw yields were noted plot wise and voiced as t ha^{-1} on 14% moisture basis.

2.11 Assortment and groundwork of plant samples

Grain and straw yields were recorded plot wise and articulated as sun dry basis. Grain and straw samples were retained for chemical analysis.

2.12 Chemical analysis of grain and straw samples

2.12.1 Preparation of sample

The illustrative grain and straw samples were dehydrated in an oven at 65°C for about 24 hours before they were crushed by a grinding machine. The prepared sample was then stored in paper bags and lastly they were reserved into a desiccators until analysis.

2.12.2 Digestion of plant samples for K determination

Plant samples of 0.5g (grain and straw separately) were transported into 100 ml digestion vessel. Ten mL of diacid combination (HNO_3: $HClO_4$= 2:1) were added into the vessel. After leaving for a while the flasks were heated at atemperature slowly raised to 20°C. Heating was stopped when the dense white fume of $HClO_4$ happened. After cooling, the contents were booked into a 50 ml volumetric flask and the volume was completed with distilled water. The digests were used for the calculation of K.

2.13 Determination of K from plant samples

5 mL of digest samples for grain and 2 mL for the straw were taken and thinned to 50 ml volume to make the wanted concentration. The K was determined from the extract by using flame photometer

2.14 Statistical analysis

The collected data were scrutinized statistically by F-test was done to observe the treatment effects and Duncan's Multiple Range Test (DMRT) was done for the mean variances (Gomez and Gomez, 1984).

3. Results and Discussion

3.1 Potassium content in BRRI dhan49 grain

Results explicitly presented in Figure 1 showed that potassium content in grain of BRRI dhan49 varied suggestively due to application of inorganic fertilizer with organic manures. K content in the grain varied from 0.26 to 0.33%. The highest K content was originated in treatment T_3 (50% K from banana leaves + 50% K from MoP) which was statistically alike to the treatment T_4 (60% K from banana leaves + 40% K from MoP). The results perceived in treatment T_2 (Recommended Fertilizer Dose) and treatment T_5 (70% K from banana leaves + 30% K from MoP) were statistically undistinguishable and the values were 0.32 and 0.30% respectively. Treatment T_6 (80% K from banana leaves + 20% K from MoP) and treatment T_7 (90% K from banana leaves + 10% K from MoP) were statistically identical and the values were 0.29 and 0.28% respectively. The lowest value of K content in grain (0.26%) was recorded in treatment T_1 (control). It was observed that K content in grain increased due to various treatments used with mutual application of organic manures and inorganic fertilizers (MoP) (Signh et al., 2001; Trivedi and Verma, 1996; Ammal and Muthiah, 1997; Mathad et al., 2002).

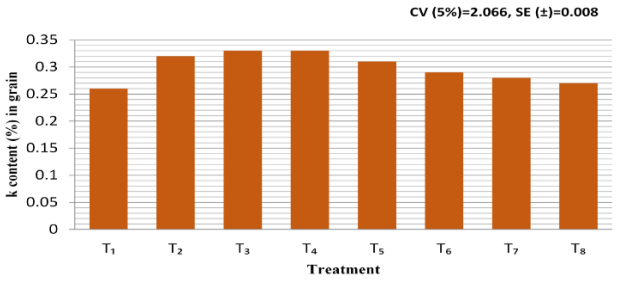

Figure 1: Potassium content (%) in rice grain of BRRI dhan49 as influenced by Banana leaves and chemical fertilizers.

3.2 Potassium content in BRRI dhan49 straw

K content in rice straw was knowingly exaggerated due to diverse treatment. It ranged from 1.08 to 1.30% (Figure 2). The highest K content in straw (1.30%) was chronicled in treatment T_3 (50% K from banana leaves + 50% K from MoP) which was statistically similar with the T_4 (60% K from banana leaves + 40% K from MoP). The lowest value of K content (1.08%) was estimated in the treatment T_1 (control). K content was increased somewhat in rice straw due to application of organic and inorganic fertilizers (MoP) and the result was statistically significant. The K contents of rice straw were always higher than those of grain in all treatments (Mitra et al., 2001; Pal et al., 2000). A group researcher exposed that K content both in grain and straw were increased due to joint application of organic manures and inorganic fertilizers (Signh et al., 2001). Varma described that incorporation of organic manures improved the concentration of K in rice grain and straw (Varma, 1991). A group researcher advocated that application of K increased soil K availability, K contents in grain and straw (Krishnappa et al., 1990).

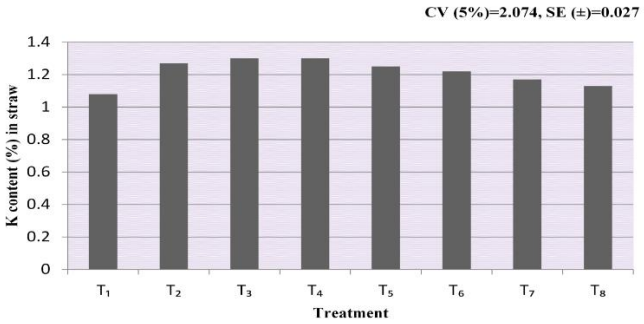

Figure 2: Potassium content (%) in rice straw of BRRI dhan49 as influenced by Banana leaves and chemical fertilizers.

3.3 Potassium uptake by BRRI dhan49 grain

The results existing in table 4 showed that potassium uptake by grain and straw of rice (BRRI dhan49) wide-ranged significantly due to different treatments. K uptake by grain varied from 8.67 to 19.46 kg ha^{-1} (Table 4). The highest K uptake value (19.43 kg ha^{-1}) by grain was found in treatment T3 (50% K from banana leaves + 50% K from MoP) which was statistically identical to treatment T4 (60% K from banana leaves + 40% K from MoP). The lowest K uptake (8.67 kg ha-1) by grain was created in treatment T1 (control). Sharma and Mitra documented the highest K uptake in organic manures and fertilizer treated plots (Sharma and Mitra, 1991). Some researcher reported that shared application of organic and inorganic fertilizer significantly amplified the uptake of NPK (Baruch et al., 1999). Chokravarti testified that K application tended to increase grain N content and total N uptake by the crop (Chokravarti, 1989).

Table 4: Potassium uptake in rice grain of BRRI dhan49 as influenced by Banana leaves and chemical fertilizers

Treatment	K Uptake (kg ha^{-1}) by rice grain
T_1	8.67e
T_2	16.98bc
T_3	19.46a
T_4	17.60ab
T_5	14.81c
T_6	15.97bc
T_7	12.41d
T_8	11.34d
C V(%)	1.27

The figure having common letter(s) in a column do not differ significantly at 5% level of significance by DMRT

In case of straw, K uptake varied from 51.40 to 89.06 kg ha^{-1}. The highest value was originated in treatment T3 (50% K from banana leaves + 50% K from MoP) which was statistically identical to treatment T_4 (60% K from banana leaves + 40% K from MoP) and the value were 89.06 and 86.57 kg ha-1 respectively (Table 5). Treatment T_2 (Recommended Fertilizer Dose) and Treatment T_5 (70% K from banana leaves + 30% K from MoP) were statistically identical in respect of K uptake and the value were 85.29 and 83.33 kg ha-1 respectively. Treatment T_5 (70% K from banana leaves + 30% K from MoP) and T_6 (80% K from banana leaves + 20% K from MoP) were statistically identical and the values were 83.33 and 81.22 kg ha-1 respectively. The lowest K uptake (51.40 kg ha-1) by straw was eminent

in the treatment T_1 (control) (Chokravarti, 1989); Krishnappa et al., 1990; Doikova et al., 199;Roy and Mathur 1989; Ghosh et al., 1994).

Table 5: Potassium uptake in rice straw of BRRI dhan49 as influenced by Banana leaves and chemical fertilizers

Treatment	K Uptake (kg ha^{-1}) by rice straw
T_1	51.40g
T_2	85.29bc
T_3	89.06a
T_4	86.57ab
T_5	83.33cd
T_6	81.22d
T_7	77.37e
T_8	67.63f
CV(%)	4.27

The figure having common letter(s) in a column do not differ significantly at 5% level of significance by DMRT

3.4 Total Potassium uptake by BRRI dhan49

The total K uptake by BRRI dhan49 ranged from 60.06 to 108.52 kg ha^{-1}. The highest total K uptake (108.52 kg ha^{-1}) was logged in the treatment T_3 (50% K from banana leaves + 50% K from MoP) (Table 6). The lowest value of total K uptake (60.06 kg ha^{-1}), was noted in the treatment T_1, (control). Application of both organic manures (Banana plant leaves) and inorganic K fertilizer significantly increased the total K uptake over control treatment, and it is completely buoyed (Pandey et al., 199; Uapdhyay, 1995; Mitra et al., 2001).

Table 6: Total potassium uptake of BRRI dhan49 as influenced by Banana leaves and chemical fertilizers

Treatment	K Uptake (kg ha^{-1}) by rice straw
T_1	60.06f
T_2	102.55b
T_3	108.52a
T_4	103.89b
T_5	98.13c
T_6	97.19c
T_7	89.78d
T_8	78.97e
CV(%)	5.41

The figure having common letter(s) in a column do not differ significantly at 5% level of significance by DMRT

4. Conclusion

It may be settled from the results that the application of banana leaves with chemical fertilizers have a constructive impression on nutrient contents and nutrient uptake of rice. Amongst the treatments, T_3 (50% K from banana leaves + 50% K from MoP) had a better performance on nutrient contents and nutrient uptake in contrast to chemical fertilizers alone. Consequently, banana leaves with inorganic fertilizer will be rewarding as addition of organic source of potassium in rice farming.

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Author's Contribution

Md. Abdul Mannan conducted the research and analyzed the data. Md. Abul Hashem and Md. Harun-or Rashid designed and supervised the experiment. Md. Sohanur Rahman contributed in research conduction, presentation, data analysis, searching journal for publication and finally manuscript processing & writing of this article. This article was read and approved by all authors for final Publication. Fakhar Uddin talukder and Nahid Kaisar helped in research conduction and manuscript writing.

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