

Original Research Article

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## Economic Feasibility of Varied Nitrogen and Potassium Application in Eggplant in Middle Gangetic Plains of Bihar

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### ABSTRACT

#### Keywords

Brinjal, Fertilizer levels, Net income, Benefit: Cost ratio

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An investigation was designed to study the economic feasibility of use of different varied levels of nitrogenous and potassic fertilizers in eggplant in two new varieties of eggplants, BRBL-01 and BRBL-07. Four levels of N ( $N_0-0$ ,  $N_1-100$ ,  $N_2-120$ ,  $N_3-140$  kg/ha; respectively) and K doses ( $K_0-0$ ,  $K_1-60$ ,  $K_2-80$ ,  $K_3-100$  kg/ha; respectively) each were taken into consideration and there were total 32 treatment combinations. The cost of cultivation per hectare for the different treatments ranged from INR 123848 to INR 129012, gross income ranged from INR 139020 to INR 432972 per hectare, net income ranged from INR 15172 to INR 304904 per hectare and benefit-cost (B:C) ratio ranged from 1.12:1 to 3.38:1. The gross income, net income and B:C ratio were highest in  $V_1N_2K_2$  (BRBL-01 applied with 120 kg/ha N, 80 kg/ha K) and this fertilizer combination was also best for the other variety. Thus, 120 kg N + 80 kg K per hectare could be used for economic benefits to eggplant growers.

### Introduction

Eggplant (*Solanum melongena* L.) is one of the most important solanaceous vegetable crops of Indian origin which is also known as brinjal or aubergine (Baigan in Hindi) and grown throughout India around the year. It is an important vegetable crop of central, south and south-east Asia and several African countries. It is good source of vitamin, particularly Vitamin B, and several minerals, viz., Ca, P and Fe etc. From the nutritional point of view, it contains 24 K cal calories,

1.4 g protein, 0.3 g fat, 4.0 g carbohydrates, 92.7% moisture, 18 mg calcium, 47 mg phosphorous, 0.9 mg Fe, 122 IU Vit A, 0.04 mg thiamine, 0.11 mg riboflavin, 0.9 mg niacin and 12 mg ascorbic acid (Thamburaj and Singh, 2013). India produces about 12.80 mt of brinjal from an area of 0.73 mha with an average productivity of 17.53 t/ha (Anonymous, 2018). The major brinjal producing states are Odisha, Bihar, Karnataka, West Bengal, Andhra Pradesh, Maharashtra and Uttar Pradesh.

Eggplant is a long duration crop and heavy feeder. Various researchers have reported various doses of fertilizers for eggplant. Choudhury (1976) opined that a good crop of eggplant required about 84 to 112 kg N, 84 to 112 kg P and 56 kg K per hectare. The highest yield of brinjal have been reported with 120 kg N + 80 kg each of P and K per hectare by Bandopadhyay *et al.*, (1972) in Bihar. Nandekar and Sawarkar (1990) reported that 120 kg N + 75 kg P<sub>2</sub>O<sub>5</sub> + 45 kg K<sub>2</sub>O per hectare produced best vegetative growth and favoured the yield attributes and produced the highest yield. On the other hand, Singh and Syamal (1995).

Eggplant has been reported to give good response to different plant nutrients of the major nutrients, nitrogen and potassium play a vital role in physiology of brinjal resulting in higher yield (Pal *et al.*, 2002). Potassium is an essential nutrient for crops and plays an important role in several physiological processes in plant (Chaitanya *et al.*, 2019).

Application of N and K have enhanced the yield and attributing traits in eggplant. But the availability of fertilizers is limited. India imports fertilizers of INR 520.45 billions (Anonymous, 2020). Besides, non-judicious use of fertilizers in crop not only increases the cost of production of the crop, but is also harmful to the environment.

Excessive use of nitrogenous fertilizer often increases the vegetative growth, thereby suppressing the reproductive stage and ultimately the fruit set is affected leading to reduced yield, that ultimately causes economic losses to the growers of the crop.

This investigation was designed to study the economic feasibility of use of different varied levels of nitrogenous and potassic fertilizers in eggplant in two new varieties of eggplant.

## Materials and Methods

The study was conducted at the Vegetable Research Farm, Department of Horticulture (Vegetable and Floriculture), Bihar Agricultural University, Sabour, Bhagalpur (Bihar) during *Kharif* season of 2018-19 which is the main season of eggplant cultivation. Different levels of nitrogen and potassium were used in combination to study their effect on the yield of two new varieties of eggplant in different segments, viz., BRBL-01 of green oblong segment and BRBL-07 of purple oblong segment. The experiment was laid out in a Factorial Randomized Block Design (FRBD) with three replications maintaining a spacing of 75 cm between rows and 60 cm between plants. There were 32 treatments, which were the combinations of three factors variety (V), nitrogen (N) and potassium (K) and there were two varieties (V<sub>1</sub>:BRBL-01, V<sub>2</sub>:BRBL-07), four nitrogen doses (N<sub>0</sub>: 0 kg/ha, N<sub>1</sub>: 100 kg/ha, N<sub>2</sub>: 120 kg/ha, N<sub>3</sub>: 140 kg/ha) and four potassium doses (K<sub>0</sub>: 0 kg/ha, K<sub>1</sub>: 60 kg/ha, K<sub>2</sub>: 80 kg/ha, K<sub>3</sub>: 100 kg/ha, respectively). A fixed dose of 80 kg/ha P was applied to all the plots as basal dose in form of single super phosphate (SSP). Besides, the total dose of K fertilizer as per treatment, in form of muriate of potash (MOP), was also applied as basal dose. Half the nitrogenous fertilizer in form of urea was applied as basal dose as per treatment in each plot. The remaining half as urea was applied in three split doses at 30 days after transplanting (DAT), 60 DAT and 90 DAT as topdress.

The plot yield was recorded as per treatment and converted to kilograms per hectare. The total cost of cultivation was calculated incorporating the cost of all inputs, land preparation, manpower, fixed costs, etc. The average selling rate (farm gate price) of eggplant was fixed as INR 12.00 per kilogram and gross income estimated from it.

Gross income = Yield × Selling rate

The net income was generated by subtracting the production cost from the gross income.

Net income = Gross income – Cost of cultivation

The benefit: cost (B:C) ratio was estimated by the following formula:

$$\text{B:C ratio} = \frac{\text{Gross income}}{\text{Cost of cultivation}}$$

## Results and Discussion

The cost of cultivation per hectare for the different treatments ranged from INR 123848 to INR 129012. Among the various treatments under study, the production cost was found to be highest in the treatment of 140 kg/ha N + 100 kg/ha K for both varieties BRBL-01 and BRBL-07. This was followed by 120 kg/ha N + 100 kg/ha K, 100 kg/ha N + 100 kg/ha K, 140 kg/ha N + 80 kg/ha K, 120 kg/ha N + 80 kg/ha K for both varieties.

Significant differences in yield in the different treatments was observed. The variety BRBL-07 was found to be higher yielder than variety BRBL-01.

The trend of yield was found increasing with increment of doses of nitrogen and potassium but K level beyond 80 kg/ha showed slight decline in yield.

The gross income ranged from INR 139020 to INR 432972 per hectare. The maximum gross income was obtained in BRBL-01 treated with 120 kg/ha N + 80 kg/ha K, followed by BRBL-07 applied with 140 kg/ha N + 80 kg/ha K, followed by BRBL-07 treated with 120 kg/ha N + 80 kg/ha K, followed by BRBL-01 applied with 140 kg/ha N + 80 kg/ha K. The least gross income was obtained

in BRBL-01 without any application of N and K fertilizers followed by BRBL-07 without any N and K treatment.

The net income ranged from INR 15172 to INR 304904 per hectare. Net income was maximum in the treatment V<sub>1</sub>N<sub>2</sub>K<sub>2</sub> (BRBL-01 applied with 120 kg/ha N, 80 kg/ha K) followed by treatment V<sub>2</sub>N<sub>3</sub>K<sub>2</sub> (BRBL-07 applied with 140 kg/ha N, 80 kg/ha K), V<sub>2</sub>N<sub>2</sub>K<sub>2</sub> (BRBL-07 applied with 120 kg/ha N, 80 kg/ha K), V<sub>1</sub>N<sub>3</sub>K<sub>2</sub> (BRBL-01 applied with 140 kg/ha N, 80 kg/ha K), V<sub>1</sub>N<sub>3</sub>K<sub>1</sub> (BRBL-01 applied with 140 kg/ha N, 60 kg/ha K) and V<sub>1</sub>N<sub>2</sub>K<sub>3</sub> (BRBL-01 applied with 120 kg/ha N, 100 kg/ha K). On the other hand, net income was minimum in the treatment V<sub>1</sub>N<sub>0</sub>K<sub>0</sub> (BRBL-01 without application of N and K) followed by treatment V<sub>2</sub>N<sub>0</sub>K<sub>0</sub> (BRBL-07 without application of N and K).

The benefit-cost (B:C) ratio ranged from 1.12:1 to 3.38:1. Among all the treatments, the highest benefit-cost ratio (B:C) of 3.38:1 was recorded in the treatment V<sub>1</sub>N<sub>2</sub>K<sub>2</sub> (BRBL-01 applied with 120 kg/ha N, 80 kg/ha K) followed by treatment V<sub>2</sub>N<sub>3</sub>K<sub>2</sub> (3.33:1 in BRBL-07 applied with 140 kg/ha N, 80 kg/ha K), V<sub>2</sub>N<sub>2</sub>K<sub>2</sub> (3.32:1 in BRBL-07 applied with 120 kg/ha N, 80 kg/ha K), V<sub>1</sub>N<sub>3</sub>K<sub>2</sub> (3.28:1 in BRBL-01 applied with 140 kg/ha N, 80 kg/ha K), V<sub>1</sub>N<sub>3</sub>K<sub>1</sub> (3.19:1 in BRBL-01 applied with 140 kg/ha N, 60 kg/ha K) and V<sub>1</sub>N<sub>2</sub>K<sub>3</sub> (3.14:1 in BRBL-01 applied with 120 kg/ha N, 100 kg/ha K). On the other hand, benefit-cost ratio (B:C) was minimum in the treatment V<sub>1</sub>N<sub>0</sub>K<sub>0</sub> (1.12:1 in BRBL-01 without application of N and K) followed by treatment V<sub>2</sub>N<sub>0</sub>K<sub>0</sub> (1.18:1 in BRBL-07 without application of N and K). This was followed by V<sub>1</sub>N<sub>0</sub>K<sub>1</sub> (1.31:1 in BRBL-01 applied with 120 kg/ha N, 100 kg/ha K), V<sub>1</sub>N<sub>0</sub>K<sub>3</sub> (1.36:1 in BRBL-01 applied with 120 kg/ha N, 100 kg/ha K), V<sub>2</sub>N<sub>0</sub>K<sub>3</sub> (1.45:1 in BRBL-01 applied with 120 kg/ha N, 100 kg/ha K), V<sub>2</sub>N<sub>0</sub>K<sub>1</sub> (1.48:1 in BRBL-01 applied with 120 kg/ha N, 100 kg/ha K) (Table 1).

**Table.1** Effect of different varieties of brinjal, and different levels of N and K On economics of different treatments and benefit:cost ratio

	Treatments	Yield (kg/ha)	Average Selling rate (Rs./kg)	Gross income (Rs./ha) (A)	Total cost of cultivation (Rs./ha) (B)	Net income (Rs./ha) (A-B)	B:C Ratio
T <sub>1</sub>	V <sub>1</sub> N <sub>0</sub> K <sub>0</sub>	11585.00	12.00	139020.00	123848.00	15172.00	1.12
T <sub>2</sub>	V <sub>1</sub> N <sub>0</sub> K <sub>1</sub>	13842.33	12.00	166104.00	125848.00	40256.00	1.32
T <sub>3</sub>	V <sub>1</sub> N <sub>0</sub> K <sub>2</sub>	17026.00	12.00	204312.00	126508.00	77804.00	1.62
T <sub>4</sub>	V <sub>1</sub> N <sub>0</sub> K <sub>3</sub>	14459.67	12.00	173508.00	127188.00	46320.00	1.36
T <sub>5</sub>	V <sub>1</sub> N <sub>1</sub> K <sub>0</sub>	16373.33	12.00	196476.00	125150.00	71326.00	1.57
T <sub>6</sub>	V <sub>1</sub> N <sub>1</sub> K <sub>1</sub>	27295.33	12.00	327540.00	127150.00	200390.00	2.58
T <sub>7</sub>	V <sub>1</sub> N <sub>1</sub> K <sub>2</sub>	32590.67	12.00	391080.00	127810.00	263270.00	3.06
T <sub>8</sub>	V <sub>1</sub> N <sub>1</sub> K <sub>3</sub>	30352.33	12.00	364224.00	128490.00	235734.00	2.83
T <sub>9</sub>	V <sub>1</sub> N <sub>2</sub> K <sub>0</sub>	16631.33	12.00	199572.00	125408.00	74164.00	1.59
T <sub>10</sub>	V <sub>1</sub> N <sub>2</sub> K <sub>1</sub>	31989.67	12.00	383868.00	127408.00	256460.00	3.01
T <sub>11</sub>	V <sub>1</sub> N <sub>2</sub> K <sub>2</sub>	36081.00	12.00	432972.00	128068.00	304904.00	3.38
T <sub>12</sub>	V <sub>1</sub> N <sub>2</sub> K <sub>3</sub>	33784.00	12.00	405408.00	128748.00	276660.00	3.15
T <sub>13</sub>	V <sub>1</sub> N <sub>3</sub> K <sub>0</sub>	19079.67	12.00	228948.00	125672.00	103276.00	1.82
T <sub>14</sub>	V <sub>1</sub> N <sub>3</sub> K <sub>1</sub>	33984.67	12.00	407808.00	127672.00	280136.00	3.19
T <sub>15</sub>	V <sub>1</sub> N <sub>3</sub> K <sub>2</sub>	35153.33	12.00	421836.00	128332.00	293504.00	3.29
T <sub>16</sub>	V <sub>1</sub> N <sub>3</sub> K <sub>3</sub>	32316.00	12.00	387792.00	129012.00	258780.00	3.01
T <sub>17</sub>	V <sub>2</sub> N <sub>0</sub> K <sub>0</sub>	11824.75	12.00	141888.00	123848.00	18040.00	1.15
T <sub>18</sub>	V <sub>2</sub> N <sub>0</sub> K <sub>1</sub>	15570.89	12.00	186840.00	125848.00	60992.00	1.48
T <sub>19</sub>	V <sub>2</sub> N <sub>0</sub> K <sub>2</sub>	17771.11	12.00	213252.00	126508.00	86744.00	1.69
T <sub>20</sub>	V <sub>2</sub> N <sub>0</sub> K <sub>3</sub>	15456.98	12.00	185472.00	127188.00	58284.00	1.46
T <sub>21</sub>	V <sub>2</sub> N <sub>1</sub> K <sub>0</sub>	24281.46	12.00	291372.00	125150.00	166222.00	2.33
T <sub>22</sub>	V <sub>2</sub> N <sub>1</sub> K <sub>1</sub>	27567.67	12.00	330804.00	127150.00	203654.00	2.60
T <sub>23</sub>	V <sub>2</sub> N <sub>1</sub> K <sub>2</sub>	31514.38	12.00	378168.00	127810.00	250358.00	2.96
T <sub>24</sub>	V <sub>2</sub> N <sub>1</sub> K <sub>3</sub>	24533.98	12.00	294396.00	128490.00	165906.00	2.29
T <sub>25</sub>	V <sub>2</sub> N <sub>2</sub> K <sub>0</sub>	25454.91	12.00	305448.00	125408.00	180040.00	2.44
T <sub>26</sub>	V <sub>2</sub> N <sub>2</sub> K <sub>1</sub>	29361.54	12.00	352332.00	127408.00	224924.00	2.77
T <sub>27</sub>	V <sub>2</sub> N <sub>2</sub> K <sub>2</sub>	35516.20	12.00	426192.00	128068.00	298124.00	3.33
T <sub>28</sub>	V <sub>2</sub> N <sub>2</sub> K <sub>3</sub>	25242.68	12.00	302904.00	128748.00	174156.00	2.35
T <sub>29</sub>	V <sub>2</sub> N <sub>3</sub> K <sub>0</sub>	32038.08	12.00	384456.00	125672.00	258784.00	3.06
T <sub>30</sub>	V <sub>2</sub> N <sub>3</sub> K <sub>1</sub>	32439.95	12.00	389268.00	127672.00	261596.00	3.05
T <sub>31</sub>	V <sub>2</sub> N <sub>3</sub> K <sub>2</sub>	35687.96	12.00	428244.00	128332.00	299912.00	3.34
T <sub>32</sub>	V <sub>2</sub> N <sub>3</sub> K <sub>3</sub>	32287.83	12.00	387444.00	129012.00	258432.00	3.00

Note: V<sub>1</sub>: BRBL-01, V<sub>2</sub>: BRBL-07, N<sub>0</sub>: 0 kg/ha, N<sub>1</sub>: 100 kg/ha, N<sub>2</sub>: 120 kg/ha, N<sub>3</sub>: 140 kg/ha, K<sub>0</sub>: 0 kg/ha, K<sub>1</sub>: 60 kg/ha, K<sub>2</sub>: 80 kg/ha, K<sub>3</sub>: 100 kg/ha

Cost of cultivation varied between the different treatments under study. The higher price of potassic fertilizers was reflected through this production cost, which led to the

enhanced cost of cultivation in the treatments with higher levels of K. Greenwood (1974) and Rahman *et al.*, (2016) previously identified chemical fertilizer cost as one of the major factors determining the production cost in eggplant.

Significant differences in yield in the different treatments were observed. The variety BRBL-07 was found to be higher yielder than variety BRBL-07. The trend of yield was found increasing with increment of doses of nitrogen and potassium but K level beyond 80 kg/ha showed slight decline in yield.

The gross income ranged from INR 139020 to INR 432972 per hectare. Rahman *et al.*, (2016) in Jamalpur district of Bangladesh reported that the gross return from eggplant cultivation was Taka 461954.45. The maximum gross income was obtained in BRBL-01 treated with 120 kg/ha N + 80 kg/ha K, followed by BRBL-07 applied with 140 kg/ha N + 80 kg/ha K, followed by BRBL-07 treated with 120 kg/ha N + 80 kg/ha K, followed by BRBL-01 applied with 140 kg/ha N + 80 kg/ha K. The least gross income was obtained in BRBL-01 without any application of N and K fertilizers followed by BRBL-07 without any N and K treatment. Higher levels of gross income were obtained with fertilizer application since it led to increment of yield. Rahman *et al.*, (2011) also reported enhanced gross return with increased rates of fertilizer application.

The net income ranged from INR 15172 to INR 304904 per hectare. The earlier work of Rahman *et al.*, (2016) showed that the net return from eggplant cultivation was Taka 317297.97. Net income was highest in treatments with 80 kg/ha potassic fertilizers and there was decline with higher doses. This was due to decline in yield at higher K levels and higher cost of potassic fertilizers. The benefit-cost ratio net reflected the net income,

which is in accordance with Rymbai *et al.*, (2012). The benefit-cost (B:C) ratio ranged from 1.12:1 to 3.38:1. Rahman *et al.*, (2016) reported that the B:C ratio for eggplant cultivation in Jamalpur district of Bangladesh was 3.29, and cultivation this crop could be a remunerative enterprise. BRBL-01 applied with 120 kg/ha nitrogen, 80 kg/ha potassium give the highest net income and benefit cost Ratio (B:C) whereas the same variety without application of N and K produced the least. This same dose yielded the highest net income and benefit cost ratio (B:C) for the other variety BRBL-07 also. Thus, for economic benefit to growers, application of 120 kg/ha N and 80 kg/ha K may be recommended.

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