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Effects of Various Fertilizer Doses on Mustard Crops under Zero Tillage System

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Authors' contributions

This work was carried out in collaboration among all authors. Author MAH designed the study, managed the literature searches, wrote the protocol and wrote the first draft of the manuscript. Authors KN and MR managed the analyses of the study. Authors MAH and KN performed the statistical analysis. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted at the BINA substation farm, Ishurdi, Pabna during 2018-2019, 2019-2020 to see the effects of various fertilizer doses on mustard plant under zero tillage system after harvest of T.aman rice. Nine treatments combination were used in the experiment. The treatments were T_1: Native soil fertility only (no fertilizer), T_2: 50% recommended N, T_3: 100% recommended N, T_4: 100% recommended NPKS, T_5:125% recommended N, T_6:125% recommended NPKS, T_7: 50% recommended NPKS, T_8: 50% recommended PKS+100%N, T_9: 50% recommended PKS+125%N. Yield and yield contributing characters were recorded. Yields and yields contributing characters of mustard were significantly influenced with the different treatments. The treatment T_4 (100% recommended NPKS) gave the highest seed yield followed by the treatment T_5 (125 % recommended NPKS) in zero tillage condition. The results indicated that 100% NPKS (T_4) or 125% NPKS (T_6) enhanced more crop growth which influenced on greater seed yield of mustard. Partial cost-benefit analysis indicated that the treatments T_8 and T_9 was greater profitable than the treatments T_4 and T_6. However, considering at maximum yields and highest net return, the treatments T_4 or T_6 could be recommended for more production of mustard in zero tillage system. Therefore, fertilizer doses of the treatment T_4 (N, P, K and S @ 90, 27, 32 and 15 kg ha^{-1}) or the treatment T_6 (N, P, K and S @ 113, 34, 40 and 19 $kgha^{-1}$) could be adopted in the cultivation of mustard for getting maximum yields under zero tillage system in late sowing condition.

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1. INTRODUCTION

Rapeseed and mustard are popularly called 'Mustard' which is a leading oilseed crop, covering about 80% of the total oilseed area and contributing to more than 60% of the total oilseed production in Bangladesh. It is a cold loving crop which is grown during Rabi season. The total area and production of mustard is 276.11 thousand hectare and 262.00 thousand tons. The present mustard yield (0.95 t/ha) is very low as compared to other oilseeds growing countries in the world. The main reasons of lower yield are lack of good quality seed and inadequate adoption of improved production technologies developed by different research institutes [1]. No tillage (NT) or zero tillage mustard (*Brassica* sp.) production has already received remarkable attention by the farmers mainly due to time, cost effectiveness and profitability [2]. Zero tillage is a potential technology in the scenario. Stresses under zero tillage are unique like heavy soil type, lack of irrigation, difficulty in fertilization due to un-open soil, residual paddy straws etc. Thus, selection of the suitable varieties for the crop under zero tillage cultivation has become an indispensable step for expanding the crop area and to raise the production [3]. Zero tillage is one of the most used RCTs Resource Conservation Technologies [4] employed for saving precious resources, which gives more economic production [5], lower production cost and saving in water and energy [6]. Zero tillage not only promotes input-use efficiency but also strengthens natural resource base [7]. In Bangladesh, after harvesting of T. aman rice, farmer's used to keep fallow land in short period of time before the cultivation of Boro rice. But now a days, many short duration mustard varieties (Like Binasharisha-9, Binasharisha-10 etc.) are available which could be cultivated between T. aman and Boro rice/Aus rice which may increase the production of oil seeds as well as cropping intensity. If residual moisture exists in the field after the harvest of T. Aman rice, mustard cultivation may be feasible under zero tillage [8-10]. Due to residual soil moisture after rice harvest, the growth and yield parameters in all rapeseed-mustard varieties were better in zero tillage than in conventional tillage because there was no rain throughout the crop period [2]. This additional oil seed can meet up the demand of edible oil in the country and can create the scope for saving the foreign currency through avoiding the import of edible oil. Generally farmer's cultivated the mustard in between of T. aman and Boro/Aus rice with conventional tillage system. Sowing period of mustard is critical and short, due to the preceding of T. aman rice in the same field. Sometimes, T. aman rice also harvested in late or sometimes heavy shower occurred in the last week of October or the first week of November in changing climatic condition which arise the causes for late sowing of mustard. In this situation, cultivation of mustard are hampered with conventional land preparation, because of conventional land preparation takes time than zero tillage systems. Information on optimum fertilizer requirement of mustard cultivation under zero tillage systems and late sowing condition is scanty. In zero tillage system, investigation is needed to find out the requirement of fertilizer for mustard cultivation in the different agro-ecological zones (AEZs) of Bangladesh. Therefore, a research has been under taken to see the effect of various fertilizer doses on mustard under zero tillage system after harvesting of T.aman rice as well as whole cropping pattern.

2. MATERIALS AND METHODS

A field experiment was conducted at the BINA substation farm, Ishurdi, Pabna during 2018-2019 and 2019-2020 cropping seasons to see the effects of various fertilizer doses on mustard under zero tillage system after harvested of transplanted aman rice (T. aman rice). Nine (9) treatments combination were used in the experiment. The treatments were T_1: Native soil fertility only (no fertilizer), T_2: 50% recommended N, T_3: 100% recommended N, T_4: 100% recommended NPKS, T_5:125% recommended N, T_6:125% recommended NPKS, T_7: 50% recommended NPKS, T_8: 50% recommended PKS+100%N, T_9: 50% recommended PKS+125%N. The experiment was carried out in a RCB design with three replications. Initial nutrient status and interpretation of soil test value have been given in the Table 1. At sowing time soil moisture was 45% in the experimental field. So, the condition of germination for seed of mustard was well in zero tillage system. Seeds of mustard (Binashrisha-9) were sown in zero tillage system on first week of December. Fertilizers were applied on the basis of soil test and the rates of fertilizer have been given in the Table 2. Tripple super phosphate (TSP), muriate

of potash (MoP), gypsum, zinc and boron were applied before the sowing of mustard seeds. Urea was top dressed in two equal splits i.e. 14 and 40 days after sowing. Weeding, irrigation and other intercultural operation were done as and when necessary. The mustard crop was harvested on the 3rd week of Feb. 2020. Yield and yield contributing characters were recorded. Different physio-chemical properties of soil samples determined with the following procedure.

2.1 Textural Class

Particle size analysis was carried out by hydrometer method [11] and finally textural class was determined by fitting the %sand, % for silt and % clay to the Marshall's Triangular Coordinates following USDA system.

2.2 Soil pH and EC

Soil pH and EC were measured by a glass electrode pH and EC meter using soil: water suspension of 1:2.5 (10 g soil and 25 ml distilled water) as described by Jackson [12].

2.3 Organic Matter

Organic carbon was determined by wet oxidation method as described by Black [11]. The underlying principle was used to oxidize the organic matter with an excess of 1N $K_2Cr_2O_7$ in presence of conc. H_2SO_4 and conc. H_3PO_4 and to titrate the excess $K_2Cr_2O_7$ solution with 1N $FeSO_4$.To obtain the organic matter content the amounts of organic carbon were multiplied by Van Bemmelen factor 1.73. The results were expressed in percentage [13].

2.4 Total Nitrogen

Total N content was determined following micro-Kjeldahl method as described by Jackson [12]. Soil sample was digested with H_2O_2, conc. H_2SO_4 and catalyst mixture (K_2SO_4:$CuSO_4.5H_20$: Se in the ratio of 100:10:1). After completion of digestion, made the volume to 100ml. Distillation was performed with adding of 40% NaOH into the digest. The distillate was received in 2% boric acid (H_3BO_3) solution and 4 drops of mixed indicator of bromocresol green and methyl red solution. Finally the distillate was titrated with standard H_2SO_4 (0.01N) until the color changed from green to pink. Then amount of N was calculated.

2.5 Available Phosphorus

Available phosphorus was extracted from the soil samples by shaking with 0.5 M $NaHCO_3$ solutions at pH 8.5 following the method of [14]. The extracted phosphorus was determined by developing blue color by $SnCl_2$ reduction of phosphomolybdate complex and measuring the intensity of color calorimetrically at 660 nm wave length and the readings were calibrated to the standard P curve.

2.6 Exchangeable K

Exchangeable K was extracted from the soil samples with 1N NH_4OAC (pH 7) and cations were determined from the extract by flame photometer [11] and calibrated with a standard curve.

2.7 Available Sulphur

Available S content was determined by extracting with 0.15% $CaCl_2$ solution (1:5 soil extractant ratio) and estimated by turbidimetric method using spectrophotometer at 535 ηm wavelength [15].

3. RESULTS AND DISCUSSION

Seed and straw yields of mustard (Binashrisha-9) were significantly influenced with the different treatments (Table 3) during 2019-2020. Maximum seed yield (1183.3 kg ha^{-1}) was obtained in the treatment T_4 (100% NPKS) followed by the treatment T_6 -125% NPKS (1116.7 kg ha^{-1}). But the treatments T_4, T_6 and T_9 gave the statistically identical results in respect of the seed yield of mustard. Rohit, 2020 reported that seed yield of mustard increased significantly with the application of 100% (RDF) recommended doses of fertilizers. Average seed yields of two years (Table 4) also found maximum in the treatment T_4 (100% NPKS) followed by the treatment T_5 (125% NPKS). The result indicated that application of all kinds of fertilizers with increasing rates have tremendous influence on seed yield of mustard in zero tillage system. The lowest seed yield was recorded in the treatment T_1 where no fertilizer was applied (Table 3 and Table 4). Similar trends were observed in case of straw yields in both the years. Yield contributing characters of mustard were also significantly influenced with the fertilizer application. The treatment of sulphur application at 45 kg S ha^{-1} made in conjunction

Table 1. Physico-chemical properties of initial soil

Soil analysis interpretation	Texture	pH	O.C (%)	Total N (%)	P ($\mu g g^{-1}$)	K (meq %)	S ($\mu g g^{-1}$)
	Silt loam	7.1 Alkaline	0.87 Low	0.11 Low	17.0 medium	0.13 Low	14.0 Low

Table 2. Rates of fertilizer applied in the experiment

Level of rates	Amount of fertilizer (kg ha^{-1})						Comments
	N	P	K	S	Zn	B	
100%	90	27	32	15	1.0	1.0	Zinc and Boron applied as basal in all the plots
50%	45	13.5	16	7.5	-	-	
125%	113	34	40	19	-	-	

Table 3. Effect of various fertilizer doses on yields and yield contributing characters of mustard under zero tillage during 2019-20 after harvested of T. Aman rice

Treatments	Seed yield (kgha^{-1})	Straw yield (kgha^{-1})	Plant height (cm)	No. of pod $plant^{-1}$	No. of seed pod^{-1}
T_1: Native soil fertility only	150.0d	733.3d	49.3e	11.7e	9.3e
T_2: 50% recommended N	183.3d	1566.7cd	67.0d	19.0e	17.7d
T_3: 100% recommended N	450.0c	2123.3bc	71.3cd	29.7cd	21.0bcd
T_4: 100% recommended NPKS	1183.3a	3750.0a	97.3ab	88.0a	25.7a
T_5:125% recommended N	640.0c	1733.3cd	66.0d	23.0cde	20.7cd
T_6:125% recommended NPKS	1116.7a	3900.0a	105.3a	97.0a	25.0a
T_7: 50% recommended NPKS	616.7c	2576.7abc	84.3bc	35.3c	23.7abc
T_8: 50%recommended PKS+100%N	900.0b	3293.3ab	97.0ab	60.0b	24.0abc
T_9: 50% recommended PKS+125%N	1016.7ab	3866.7a	95.7ab	86.7a	24.7ab
CV(%)	**16.19**	**17.5**	**10.95**	**15.82**	**10.1**

Table 4. Average seed and straw yields of mustard during 2018-19 and 2019-20 as affected by different treatments

Treatments	Seed yield (kgha^{-1})		Average seed yield (kgha^{-1})	Straw yield (kgha^{-1})		Average straw yield (kgha^{-1})
	2018-19	2019-20		2018-19	2019-20	
T_1: Native soil fertility only	55.0e	150.0d	102.5	335.0f	733.3d	534.15
T_2:50% recommended N	292.3d	183.3d	237.8	1033.3e	1566.7cd	1300
T_3:100% recommended N	588.3c	450.0c	519.15	2016.7d	2123.3bc	2070
T_4:100% recommended NPKS	1116.7a	1183.3a	1150	3576.7a	3750.0a	3663.35
T_5:125% recommended N	598.3c	640.0c	619.15	2240.3c	1733.3cd	1986.8
T_6:125% recommended NPKS	1118.3a	1116.7a	1117.5	3570.0a	3900.0a	3735
T_7:50% recommended NPKS	305.0d	616.7c	460.85	1150.0e	2576.7abc	1863.35
T_8:50% recommended PKS+100%N	1070.0a	900.0b	985	3050.0b	3293.3ab	3171.65
T_9:50% recommended PKS+125%N	1073.3a	1016.7ab	1045	3186.7b	3866.7a	3526.7
CV (%)	8.56	**16.19**		6.93	**17.5**	

Table 5. Partial cost-benefit analysis of mustard as affected by different treatments under zero tillage system

Treatments	Total Gross return (Tk.)	Fertilizer. Cost (Tk.)	Net return (Tk.)	Marginal return (Tk.)	MBCR
T_1	7240	-	7240	-	-
T_2	16979	1575	15404	9739	9.9
T_3	34763	3150	31613	27523	10.0
T_4	74240	7905	66335	67000	8.4
T_5	40014	3955	36059	32774	9.1
T_6	72668	9940	62728	65428	6.3
T_7	30937	3952.5	26984	23697	6.8
T_8	63690	4445	59245	56450	13.3
T_9	68055	5250	62805	60815	11.9

Mustard seed=55 Tk kg^{-1}, Mustard straw=3 Tk. kg^{-1}, N= 35 Tk. kg^{-1}, P=110 Tk. kg^{-1}, K=30 Tk. kg^{-1}, Gypsum=55 Tk. kg^{-1}, 1 USD$=87.63 TK

with 120 kg N ha^{-1}, are best than all other treatments for achieving the highest traits of expression of growth, seed productivity and seed quality parameters and it was found by Yadav, [16]. The treatments T_4 and T_6 gave almost similar results regarding yield contributing characters of mustard but both the treatments gave the highest plant height, number of pods $plant^{-1}$ and number of seeds pod^{-1} among all the treatments (Table 3). Singh, 2017 found that the interaction between S and B had significantly effect on seed and stover yields of mustard and maximum yields were recorded under 60 kg S ha^{-1} and 2 kg B ha^{-1} which was statistically at par with 40 kg S ha^{-1} and 2 kg B ha^{-1}.Thre present findings are well corroborated with those earlier findings. The results revealed that 100% NPKS or 125% NPKS enhanced more crop growth which influenced the seed yield of mustard in late sowing condition under zero tillage systems.

Partial benefit-cost analysis showed (Table 5) that maximum gross return (Tk, 74240/-) and net return (Tk. 66335 /- were obtained in the treatment T_4 followed by the treatment T_6. But maximum MBCR (Marginal benefit cost ratio) was obtained in the treatment T_8 (13.3) followed by the treatment T_9 (11.9). Partial cost-benefit analysis indicated that the treatments T_8 and T_9 were greater profitable than the treatments T_4 and T_6. However, considering of maximum yields and highest net return, the treatments T_4 (100% NPKS) or T_6 (125% NPKS) could be recommended for more production of mustard. Buah, 2017 reported that no tillage, whether for maize or soybean, were likely increase grain yield and economic returns. The present results are well agreement with the earlier findings.

4. CONCLUSION

Considering the maximum yields and highest net return, fertilizer doses of the treatment T_4 (N, P, K and S @ 90, 27, 32 and 15 kg ha^{-1}) or the treatment T_6 (N, P, K and S @ 113, 34, 40 and 19 kg ha^{-1}) could be adopted in the cultivation of mustard for getting maximum yields and income under zero tillage system in late sowing condition.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Miah MAM, Rashid MA, Shiblee SAM. Assessment of socioeconomic impacts of oilseed research and development in Bangladesh. Final report submitted to the Agricultural Economics and Rural Sociology, BARC, Farmgate, Dhaka; 2014.
2. Sushan Chowhan, Majharul Islam, Kamrun Nahar, Md. Khan Jahan Ali and Muhammad Maruf Husain. No Tillage Cultivation of Mustard Requires Definite Boron Dose for Optimizing Seed Yield. International Journal of Plant & Soil Science. 2022;34(1): 105-114.
   Article no.IJPSS.84086 ISSN: 2320-7035.
3. Sanatomba Yambem, Lydia Zimik, Bibek Laishram, Surajkumar Sharma Hajarimayum, Menson Keisham and Laikhuram Banarjee. Response of different rapeseed (*Brassica campestris*) and mustard (*Brassica juncea*) varieties on growth and yield under zero tillage conditions. The Pharma Innovation Journal. 2020 9(12):210-212.
   Available:DOI:https://doi.org/10.22271/tpi.2020.v9.i12d.5433.
4. Gupta KR. RCT induced impacts in Indo-Gangetic Plains. RWC research highlights, 2006. Rice Wheat Consortium for Indo-Gangetic Plains. New Delhi, India; 2007.
5. Hobbs PR, Gupta RK, Ladha JK, Balasubramanian V. Crop establishment and management new opportunities for enhancing rice-wheat system productivity. In: Rice-Wheat consortium for the Indo-Gangetic Plains, Rice-Wheat consortium paper series 14, New Delhi. 2002;10-30.
6. Reifschneider F. Doubley green revolution. Our planet, the magazine of the United Nations environment programme, agriculture and economic development (special edition). UNEP, Nairobi, Kenya; 2007.

7. Laxmi V, Mishra V. Factors a□ecting the adoption of resource conserving technology, case study of zero tillage in rice-wheat farming system. Indian Journal of Agricultural Economics. 2007;62(1):126-38.
8. Rohit, Jitendra Singh. Effect of potassium application on seed yield of mustard in Agra, International Journal of Ecology and Environmental Sciences; 2020.
DOI: 1013140/RG.2.2.29214.77121.
9. Ranvir Singh, Yogesh Singh and Sarika Singh, Yield, quality and nutrient uptake of Indian mustard (Brassica juncea) under sulphur and boron nutrition, Annals of Plant and Soil Research. 2017;19(2):227 – 231.
10. Samuel Saaka Jeduah Buah, Hashim Ibrahim, Mavis Derigubah, Martin Kuzie, James Vuuro Segtaa, Jules Bayala, Robert Zougmore and Mathieu Ouedraogo. Tillage and fertilizer effect on maize and soybean yields in the Guinea savanna zone of Ghana. Agriculture & Food Security. 2017;6:17.
DOI: 101186/s40066-017-0094-8.
11. Black CA. Methods of Soil Analysis. Part I and II. American Soc. of Agron. Inc. Pub. Madison, Wisconsin, USA; 1965.
12. Jackson ML. Soil Chemical Analysis. Constable and Co. Ltd. London; 1962.
13. Page AL, Miller RH, Keeney DR. Methods of Soil Analysis part II. 2nd ed. Amer. Soc. Agron. Inc. pub. Madison, Wisconsin, USA; 1989.
14. Olsen SR, Sommers LE. Phosphorus. In: A. L. Page, et al. (eds.) Methods of soil analysis: Part 2. Chemical and microbiological properties. Agron. Mongr. 9. 2nd ed. ASA and SSSA, Madison, WI. 1982;403-430.
15. Williams CJ, Steinbergs A. Soil sulfur fractions as chemical indicates of available sulfur in some Australian soils. Aust. J. Agric. Res. 1959;10:340-352.
16. Mahipat Singh Yadav, Dhanai CS. Effect of fertilizers on yield and yield attributing characters of mustard (*Brassica juncea L*. Czern & Coss), Journal of Pharmacognosy and Phytochemistry. 2018;7(2):2300-2303. E-ISSN: 2278-4136 P-ISSN: 2349-8234 JPP

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