

TECHNICAL BULLETIN

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Improvement and Validation of the BARI Seeder Machine for Grain Crops

In Bangladesh, the use of agricultural machinery at farmers' field levels has increased significantly over the years, but farm mechanization still remains inadequate in terms of material and services, and farmers' continue to rely heavily on human labor for agricultural operations including land preparation, crop establishment and husbandry, harvest, post-harvest processing and marketing of produce. Agriculture with human labor is tedious, time consuming and



The BARI seeder machine hitched to a power tiller



Seed pot and seed plate of the BARI Seeder machine

expensive. A continuing shift of labor from agriculture to off farm enterprises in the country has complicated things resulting in an acute labor shortage and spiraling wages. Farm mechanization involves tools, implements and powered machinery as inputs to increase farm labor productivity. The most popular farm machines in Bangladesh are power tillers, irrigation pumps, sprayers, rice-wheat threshers, Maize shellers and trailers, etc. In most parts of Bangladesh, Rabi crops (winter crops) are cultivated following the harvest of transplanted Aman rice (T. Aman, monsoon rice), but the Rabi crop yield is usually very low due, mainly, to delayed planting. Generally, to establish Rabi crops, land is prepared after T. Aman harvest with 3-4 tillage runs of a power tiller followed by hand broadcasting of seeds, which is both costly and time consuming delaying Rabi establishment, and ultimately yield losses occur. To address these problems, the Farm Machinery and Postharvest Process Engineering Division, Bangladesh Agricultural Research Institute (BARI), Gazipur, in collaboration with R. K. Metal, a private enterprise in Faridpur developed a seeder machine capable of land preparation, sowing of seeds in line and seed



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covering in a single pass, enabling farmers to quickly establish Rabi crops after T. Aman rice harvest making best use of the residual soil moisture with minimal costs in terms of fuel and labor. However, in field trials of the seeder machine, some manufacturing faults were detected such as, excess weight, non-uniformity of seed dropping, etc., and attempts were made to solve the problems. This project was designed to standardize the machine for uniform seeding of different grain crops, evaluate its field performance on different soil types. The improved BARI seeder was extensively field tested for Rabi crops as a machine for reduced tillage (PTOS), strip tillage (ST) and zero tillage (ZT) in comparison with conventional tillage by power tiller (PT) in project areas of the districts of Rajshahi and Patuakhali under silty clay loam and clay loam soil conditions, respectively.

Results and Outputs

Engineering and agronomic efficiencies

One big problem of the earlier version of the BARI seeder was its excess weight making it uncomfortable for the operator. In the modified version, weight was reduced by 23 kg through a reduction in the weights of the base plates, improving the machine's maneuverability. These changes improved performance of the seeder machine. The seed to seed



Tillage with the seeder machine

distance for Maize was increased from 4.50 to 4.83 cm, almost equaling the desired spacing of 5.0 cm. The seed distribution uniformity with the modified machine was 97.33% compared with 90% with the earlier version. The planting depth uniformity of the earlier version was much lower (79.0%) than that for the improved seeder (97.58%) which was very close to the desirable planting depth uniformity of 100%.

The width of tilling with the BARI seeder was double that with the of conventional method (PT). However, the forward speed of the BARI seeder was less than that of PT, but the lower speed of the former was compensated for by its greater tilling width. In Rajshahi, the effective field capacities of PTOS, ST, ZT and PT were found to be 0.106, 0.105, 0.102 and 0.086 hahr⁻¹, and the field efficiencies of PTOS ST, ZT, and power tiller were estimated as 75.83, 76.64, 76.77 and 78.32%, respectively. The low field efficiencies were attributed to machine operation in small plots where frequent turnings (loss of functional time) were required. Fuel consumptions for PTOS, ST and ZT were similar but PT consumed more fuel because it required at least three passes for complete land preparation whereas in PTOS, ST and ZT, land preparation and seeding were accomplished in a single pass. The BARI seeder (PTOS, ST and ZT) saved about 72% fuel relative to the conventional PT. Similar performances of the seeder machine and PT were observed in Patuakhali, but greater tilling and higher field capacities were observed there. Fuel saving by the BARI seeder was 60% compared with PT in Patuakhali.

Field performances of different seed planting machines, Kalapara, Patuakhali, Rabi 2019-20

Tillage system	Reqd. tillage passes	Forward speed (km ha ⁻¹)	Tillage		Fuel use (L ha ⁻¹)	Effective field capacity (ha ⁻¹ hr)	Field efficiency (%)
			Width (cm)	Depth (cm)			
PTOS	Single	1.38	120	6.15	11.77	0.109	78.43
ST	Single	1.33	120	6.12	11.57	0.108	77.54
ZT	Single	1.36	120	3.98	12.14	0.103	76.81
PT	Two	1.86	60	7.52	28.74	0.087	78.73

PTOS=power tiller operated seeder; ST=strip tillage; ZT=zero tillage; PT=power tiller (conventional tillage)

During Rabi 2019-20, with the improved seeder, 7.20 ha of land were cropped (Wheat 6.15 ha, Maize 0.36 ha and Lentil) at the Rajshahi project locations and 3.98 ha (1.28 ha⁻¹ Maize, 2.31 ha⁻¹ Mungbean, and 0.36 ha Cowpea) were planted at the Patuakhali project locations. The highest crop yields were obtained from reduced tillage (PTOS) outdoing the ST, ZT or PT method except in case of Wheat. In Rajshahi, the highest yield of Wheat was achieved with ST followed by PTOS. The field performance of the seeder machine was found satisfactory and gained farmer acceptance in both Rajshahi and Patuakhali.

The fixed cost and variable costs for seeder machine operation were estimated as Tk. 2460 ha⁻¹ and Tk. 1976 ha⁻¹ whereas those for PT were Tk. 1886 ha⁻¹ and Tk. 3254 ha⁻¹, respectively. The areas under the seeder machine and PT per year were 26 and 13 ha⁻¹, respectively showing that the machine tilled double land area compared with PT. Again, the custom hiring charge for both machines was estimated as Tk. 7,000 ha⁻¹, and the average revenue that could be received by the owner of the seeder machine was Tk. 66,664 per year and that by the PT owner was Tk. 24,180 per year. Thus, a local service provider or a seeder machine owner could earn an additional Tk. 42,484 per year. The pay back period was analyzed to be 2.93 years for the seeder machine operation and 3.63 years for PT operation. The average rate of return on investment for a seeder machine was found to be 1.54 that is higher than unity, which is a profitable venture for an entrepreneur compared with that for PT (1.08).

Benefits and Outcomes

- ❖ The improved seeder can save time for land preparation and facilitate line sowing of seeds
- ❖ The seeder machine can save up to 50-70% fuel for land preparation and seed sowing
- ❖ The machine tilling-cum-seed sowing is an environment friendly technology due to its relatively low fuel consumption and carbon emission

Expected impacts

The BARI seeder machine can be used for conservation agriculture (reduced/strip/zero tillage with some fitting arrangements). The payback period for the seeder is 2.93 years and the benefit cost ratio is 1.54. Machine operators/farmers can develop skills through training. Local

workshops and manufacturing facilities can fabricate the machine and make profits. The machine is acceptable to farmers, and in view of this, the Department of Agricultural Extension has undertaken a project for distribution of 5000 seeder/bed planter machines to farmers with a 50-70% subsidy during the period July 2020 to June 2025.

Recommendations

The improved BARI seeder is recommended for use by farmers as a single pass reduced tillage/strip tillage/zero tillage cum seeding tool for upland field crops all over the country. Hands on training should be provided to operators for efficient field operation of the machine. This machine operated tillage-seeding technology needs to be disseminated to the farmers through training, field demonstrations and mass media broadcasts and reports.

Future research should be undertaken to determine optimum seed rates for the machine to grow different crops as well as to fine tune water and fertilizer management for conservation agriculture practices on different soil types.

This technical bulletin has been prepared on the basis of technical information available from a completed CGP project of KGF, the details of which are given below:

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