Performance of the Versatile Multi-crop Planter (2010-2017)

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Introduction

In South Asia where cropping intensity is high, small farms may grow three or more crops in a year and over a 5-year cycle due to changing profitability of crops cultivate 4-6 crops with diverse seed sizes, seed rate, row spacing, fertiliser rates, seeding depth etc. Hence a planter for such diverse cropping systems needs to have multi-functional capabilities. Service providers also need to be able to hire out their planter for business all-year-round to justify the investment cost. There are a number of other criteria and challenges that would need to be satisfied by potential purchasers of a planter including low purchase price; sufficient earning capacity; flexible set up in the field with capability to be modified quickly for different seed rate, fertiliser rate, row spacing, seed size, planting depth; durable and reliable in operation, and; light weight with minimal vibrations. The VMP was designed to meet the above criteria and has successfully established a diverse range of crops in Bangladesh since 2008 (Haque et al., 2011).

Materials and Method

The VMP was powered by a Dongfeng or Saifeng 12 - 16 horsepower 2-wheel tractor (2WT). The VMP has designed with capability for seeding and fertilizing with fluted roller or vertical plate meters in lines for: 1) Single-pass shallow-tillage (SPST); 2) strip planting (SP); 3) zero tillage (ZT); 4) bed planting (BP) (for single-pass new bed-making or re-shaping of permanent beds together with simultaneous planting and fertilizer application); and 5) conventional tillage (CT) using full rotary tillage following broadcast seeding and fertiliser spreading. On-station and on-farm replicated trials were conducted with different tillage options and seed calibration to assess effective field capacity, fuel consumption, crop establishment and yield; and analyzed by MSTAT-C. A typical example of performance is shown in Table 1 from a clay soil of the High Barind Tract, Rajshahi, Bangladesh, 2010-11, but many other examples are available on request.

Results and Discussion

The field capacity of VMP was 0.07 ha hr^{-1} for SP which was 57 % higher than for CT. Land preparation cost by VMP was decreased by up to 75 % for single pass compared to CT. The VMP was capable of sowing many crops from small jute seed (2 g/1000 seeds) up to maize (160 g/1000 seed). The VMP weighs 152 kg and ex-factory price is US$900. Significant variation was observed on field capacity when operated for CT, SPST, SP, ZT and BP: 0.03, 0.07, 0.07, 0.06 and 0.05 ha hr^{-1}, respectively (Table 1). Fuel consumption was highest for CT (33.1 l ha^{-1}) and lowest in SP (5.83 l hr^{-1}) by VMP (Table 1). The SPST, SP, ZT and BP by VMP saved 38, 82, 50 and 13 % diesel fuel over CT. The maximum cost (US$ 41.47 ha^{-1}) of land preparation and seeding was incurred in case of CT system and the lowest (US$ 10.27 ha^{-1}) for SP (Table 1). Compared to CT, planting by SPST, SP, ZT, and BP systems lowered costs by 52, 75, 23, and 13 %, respectively (Table 1). The VMP with a vertical plate seed meter placed 96 % of maize plants 180 to 260 mm apart (mean 205 mm; SE ± 3.9 mm) with a single-pass operation. Indeed, the spacing between plants was more consistent than maize planted by hand in well-prepared land after four tillage operations (data not shown here).

Based on feedback from operators who found seed rate calibration difficult, seven vertical meters for different seed size have been developed to regulate the seed rate without further calibration. Also, to optimize the price, minimize the weight, and balance the weight, substantial improvement was made on VMP during 2015 and 2016. Significant improvements were made on the shank of the furrow opener to increase its strength, and the seed-boot and fertilizer-orifice of the furrow opener were modified to minimize seed and fertilizer contact.

Since 2010, a total of 198 units of different models of VMP have been manufactured and sold (98, 63, 23, 12, and 2 units by Hoque Corporation, Alam Engineering, Alim Industries, Janata Engineering, and Tongi Engineering) locally and 40 units exported to 9 countries (Mexico - 15, India - 11, Ethiopia - 6, Vietnam 2, Zimbabwe 2, Kenya 1, Myanmar 1, Tanzania 1, and Uganda 1). During 2012 to 2015, 2016, and 2017; a total of 6, 18, 50 VMPs were monitored closely to collect performance data. Total area coverage of the monitored VMPs were 39, 70, 150, 246, and 943 ha; and service was provided to 187, 523, 1115, 1014, and 3772 farmers during 2012-13, 2013-14, 2014-15, 2015-16, and 2016-17.

Hoque Corporation, Dhaka is involved to commercialize the VMP, and sold 115 units since the rabi season of 2016. In collaboration with Barind Multipurpose Development Authority (BMDA) and National Bank Ltd., Hoque Corporation identified 62 new LSP in Naogaon district, where, National Bank provided a 3-year loan package of Taka 170,000 to each LSP without any property mortgage. During the VMP handover program to LSPs, the BMDA and National Bank Ltd. agreed to extend the loan program for VMP in other districts of Bangladesh.

Conclusions

The VMP is a unique multi-functional and multi-crop planter powered by 12-16 hp 2WT with capability for seed and fertilizer application at variable rates, depth and row spacing using SPST, SP, ZT, BP, and CT. The square shaft and brackets designed for the VMP achieve improved flexibility for multi-crop planting and capacity for rapid adjustment of row spacing on a field-by-field basis. By using the VMP, the establishment costs for various crops in different tillage systems were significantly reduced compared to CT. Planters such as VMP could be used to develop CA practices across a wide range of cropping systems used by smallholder farmers in Bangladesh, and other regions of South and Southeast Asia and Africa.

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Reference

Haque, M.E., Bell, R.W., Islam, A.K.M.S., Sayre, K., Hossain, M.M., 2011. Versatile multi-crop planter for two-wheel tractors: an innovative option for smallholders. In: 5th World Congress of Conservation Agriculture. 26–29 September 2011, Brisbane, Australia, pp. 102-103.

Table 1. Effect of tillage mode by the Versatile Multi-crop Planter on fuel consumption, field capacity, labour requirement and cost of land preparation and seeding of lentil, chickpea, mung bean and black gram in clay soil at High Barind Tract, Rajshahi, Bangladesh, 2010-11.

Tillage type	Field capacity (ha hr^{-1})	Fuel consumption (l ha^{-1})	Labour requirement (person-hr ha^{-1})	Cost of land preparation and seeding[a], (US$ ha^{-1})
Conventional tillage (4 tillage passes)	0.03c	33.1a	48.1a	41.5a
Single pass shallow tillage	0.07a	20.6c (38)	15.4c (68)	19.8d (52)
Strip planting	0.07a	5.83e (82)	15.3c (68)	10.3d (75)
Zero tillage	0.06ab	16.6d (50)	17.3c (64)	18.1c (23)
Bed planting	0.05b	28.9b (13)	23.9b (51)	28.8b (13)
LS	**	**	**	**

Values in parentheses indicate the percent saving over CT. Values in a column, followed by a common letter are not significantly different at $P < 0.01$ by Duncan's Multiple Range Test.

[a]Considering variable costs for labour (land preparation @Taka 30 and seeding @Taka 20/ha); diesel fuel (@Taka 45/l). 1 US$ = 68 Taka