Comparative levels of soil disturbance under reduced and minimum tillage types with two-wheel tractor planting operations

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Introduction

Minimum soil disturbance is one of the key principles of conservation agriculture (CA). However, little is known about levels of soil disturbance caused by 2-wheel tractor (2WT) - based planters being used in small farms to practice CA (Haque et. al., 2013). Several types of single pass minimum soil disturbance are being used to establish crops in Bangladesh. To quantify the impact of various tillage types on soil disturbance, breakage of soil aggregates, and operational cost, a study was carried out during 2015 at two long-term CA sites at Godagari upazila, Rajshahi; and Baliakandi upazila, Rajbari. The aim was to determine which forms of planting involve minimum soil disturbance according to the requirements of CA.

Materials and Method

The single pass tillage treatments were zero tillage (ZT), single pass full tillage (SPFT), strip tillage with straight blade (STSB), strip tillage with bent blade (STBB), permanent bed - reshaping (PBR), new bed forming (NB), all of which were compared with four full tillage passes by 2-wheel tractor (2WT) as conventional tillage (CT). The Versatile Multi-crop Planter (VMP, Haque et al., 2011) was used for all single pass tillage operations and a Dongfeng brand 16hp 2WT was used for CT. The soil types were silty clay, and sandy-loam in Godagari and Baliakandi sites, respectively. The experiments were laid out as a randomized complete block design with three replications. Data on effective field operating capacity of the machinery, fuel consumption requirements, amount of loosened soil, tillage depth, etc. were recorded and analyzed by MSTAT-C program.

Results and Discussion

Significantly ($P<0.01$) higher field operating capacity was recorded for all single pass tillage operations than for CT. The maximum effective field operating capacity was recorded for ZT, SPFT, STBB, STSB in Gogagari followed by NB and PBR. In Baliakandi, the highest field operating capacity was recorded for STBB which was statistically similar to SPFT and STSP, but higher than NB and ZT. The effective field operation capacity for PBR at Baliakandi was significantly higher than CT but significantly lower than all other tillage methods (Table 1). The highest fuel consumption was reported for CT in both locations in Godagari and Baliakandi, respectively) and lowest was reported for STSB in both locations (Table 1). Highest amount of soil disturbed (loosened soil due to tillage) was reported for CT in both locations, in Godagari and Baliakandi, respectively and for SPFT in Baliakandi which was statistically similar to NB at Godagari. The lowest amount of soil disturbance was reported for ZT in Godagari and Baliakandi followed by STBB at Godagari, STBB at Baliakandi and STSP in same location (Table 1). The maximum tillage depth was reported for NB and PBR in Godagari; and the lowest was for SPFT in Baliakandi and STBB in Godagari (Table 1).

Conclusions

The results confirmed that SPFT, PBR and NB cannot qualify for minimum soil disturbance tillage systems as the soil disturbance was comparable to CT, while soil disturbance by the ZT, STBB and STSB involved minimum soil disturbance.

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Reference

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Table 1. Evaluation of different tillage type on fuel consumption, effective field operating capacity, amount of loosened soils, and depth of tillage at Godagari and Baliakandi upazilas of Bangladesh.

Tillage type	Effective field operating capacity (ha hr^{-1})	Fuel Consumption (l ha^{-1})	Amount of loosened soils (t ha^{-1})	Maximum depth of tillage (cm)
Godagari				
ZT	0.08a	11.8cd	83d	6.3cd
SPFT	0.08a	12.5c	476b	5.9cd
CT	0.03d	34.2a	558a	8.9b
STBB	0.08a	11.7cd	172c	5.7d
STSB	0.08a	10.5d	139cd	6.4c
PBR	0.05c	15.4b	464b	10.9a
NB	0.06b	14.3b	539ab	11.5a
LS	**	**	**	**
Baliakandi				
ZT	0.06b	11.7e	87d	6.08c
SPFT	0.07a	12.1e	648a	5.08d
CT	0.03d	33.7a	587a	6.26c
STBB	0.08a	9.30f	285c	6.23c
STSB	0.07a	14.1d	301c	6.53c
PBR	0.05c	31.4b	417b	10.20b
NB	0.06b	25.4c	408b	11.06a
LS	**	**	**	**

ZT - zero tillage; SPFT - single pass full tillage; CT - four full tillage passes by 2-wheel tractor as conventional tillage; STBB-strip tillage with bent blade; STSB - strip tillage with straight blade, PBR - permanent bed - reshaping, NB - new bed forming, LS = Level of significance; ** mean significant at 1%.