Weed seed bank dynamics in long term trials of conservation agriculture

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Introduction

Conservation agriculture (CA) has been identified as an effective tool for sustainably increasing the crop yields but weed control is perceived as one of the most challenging issues (Pittelkow *et al.,* 2015). Due to the reduction in tillage operations, weed seed bank composition and dynamics in CA will change compared to conventional tillage. Soil weed seed bank is the reservoir of weed seeds in the soil which determines the species composition. The seed bank is the most important source of weeds and represents a significant point in the weed life cycle and weed population is directly related to their seed bank. Knowledge of the seed bank size and its composition can be used to predict the future weed infestation and control strategies, weed seed production after the cropping season, estimation of crop-weed competition and crop yield loss and the crop economics as well (Begume *et al.,* 2006). There are very few studies examining the effects of CA principles on weed seed bank dynamics. These types of studies are needed to include weed control in cost-benefit analyses concerning the adoption of CA. Considering this fact, long terms CA trials were conducted to examine the effect of CA principles on weed seed bank dynamics.

Materials and Methods

The net house experiment was conducted at Bangladesh Agricultural University, Mymensingh, Bangladesh from October 2013 to November 2016. Soil was collected from the field of long term CA trials located at the Durbacahra village of Gouripur upazila under Mymensingh district of Bangladesh. In a *T. amna-mustard- boro rice* cropping rotation, crops were grown under conventional tillage (CT) and strip tillage (ST) with the retention of 50% crop residues compared to no-residue. Before the setting up of the trials, five soil samples from each plot were collected from 0-5 cm, 5-10 cm and 10-15 depth following “W” shape pattern. One kilogram of soil from each plot were placed in individual plastic dish having 32 cm diameter. The samples were kept moist to facilitate good weed germination. The emerged seedlings were identified, counted and removed at 30 days’ intervals throughout 1 year period. Seedlings of questionable identity were transferred to another dish and grown until maturity to facilitate identification. After the removal of each batch of seedlings, soils were thoroughly mixed and re-wetted to permit further emergence. This process was repeated 12 times. Counted seedling were converted to numbers per m^2. After the end of 2-years field trials of Gouripur, soil samples were collected again following similar procedure and the same experimental protocols were performed at the net house.

Results and Discussion

Effect of tillage practice and residue mulching on the number of weed species

Effect of ST and retention of 50% crop residues was significant on the number of weed species. Before setting the long-term CA trials in 2013, there was no significant difference in the weed species for CT and ST. During this time, there was 59 species in CT and 62 species in ST indicating the homogeneity of weed seed bank in the field. After 6 field trials of two-year study, there was 20% higher weed species in CT (71 species) but 7% less species in ST (58 species) (Fig. 1). Retention of 50% crop residue in the field caused to decrease the weed species by 9% after 2-year study compared to the before study (Fig. 2).

Effect of CT, ST and residue mulching on weed density (number per m^{-2}) at different soil depth

The highest weed density was recorded from 0-5 cm depth followed by 5-10 and 10-15 cm depth both in CT and ST during both of before and after field trials (Table 1). After 2-year crop cultivation CT caused to increase the weed density by 13%. Data recorded from after 2-year study also reveals that, heavy pulverization in CT caused to increase density by 11% at 0-5 cm depth and 25% at 5-10 cm depth but decreases by 53% at 10-15 cm depth which might be attributed from continuous upward movement of weed seeds to the upper layer of soil.

After 2-year cropping, ST reduced the seed bank size by 22%. It was also found that, ST reduced the weed seeds by 24% at 0-5 cm and 57% at 10-15 cm depth but increased by 25% at 5-10 cm depth. Minimal soil disturbance may cause to emerge the weeds from upper most layer leading to reduce seed bank size and deposition of seed to the middle layer leading to enrich seed bank. Soil compactness at the lowest layer may have increased seed dormancy and mortality and reduced seed bank size. Two year cropping with the retention of 50% residue reduced the seed bank by 11% and there was a decreasing trend in seed numbers from upper to lower soil layer. Residue may hinder weed growth and favour weeds seed predation by soil fauna and reduce the weed seed bank. The seed bank was more or less stable after 2-year study in no-residue practice. From these results, it is clear that, CA practice may lead to a reduction in the soil weed seed bank.

References

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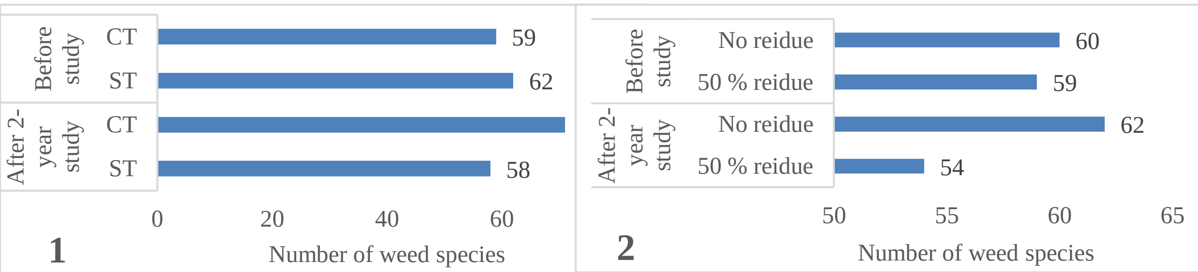

Figure 1: Effect of **(1)** CT and ST and **(2)** crop residue mulching on weed seed bank composition after 2- year filed trials of CA practices