Journal of Agroecology and Natural Resource Management
p-ISSN: 2394-0786, e-ISSN: 2394-0794, Volume 7, Issue 1; January-March, 2020, pp. 7-10

http://www.krishisanskriti.org/Publication.html

Role of Soil Microbial Population under different Tillage Practices in Chickpea (*Cicer arietinum L.*)

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Abstract—*Tillage management practices play key role for higher production of chickpea as a second crop where crop only can survive with residual soil moisture. Field experiment was conducted during rabi season of 2016 to 2017 at the D- Block Farm, Bidhan Chandra Krishi Viswavidyalaya, Kalyani (22º96' North latitude and 88º42' East Longitude) to study the tillage practices on yield and microbial population of chickpea. The treatments included six tillage management practices viz. T_1= Conventional tillage followed by line sowing (CT+LS), T_2= Direct seeding in un-tilled field with plough (DS+PM), T_3= Direct seeding in un-tilled field with zero till drill (DS+ZTD), T_4= reduced tillage (one harrowing +planking) followed by line sowing (RT+LS), T_5= Broadcasting seed followed by reduced tillage (BS+RT), T_6= Broadcasting seed in standing rice before 15 days of its harvest (BS+RC). Relay cropping recoded highest plant height (55 cm). Maximum pod per plant (68) was recorded in relay cropping treatment. Maximum yield was recorded significantly in relay treatment (1413 kg ha^{-1}). The maximum total bacteria (245 × 10^6 CFU/g) were calculated in CT+LS treatment followed by broadcasting seed in standing rice before 15 days of its harvest treatment (240 × 10^6 CFU/g). The maximum number (106 × 10^5 CFU/g) of total actinomycetes also recorded in relay cropping treatment.*

1. INTRODUCTION

Chickpea is an important and widely grown pulse crop in India since ancient time. Chickpea is popularly known as Bengal Gram in India. Chickpea is consumed as leafy vegetable, chana dal, flour as well as fodder. Variety of snacks, sweets and dishes can be made out of chickpea flour. It contains around 25% proteins and 60% carbohydrates. The Desi type chickpea contribute to around 80% and the Kabuli type around 20% of the total production. India is the largest producer of this pulse contributing to around 70% of the world's total production. In India, Chickpea production was 7170 thousand tonnes in 2015-16 whereas in 2013-14 it was 9530 thousand tonnes [2]. For higher chickpea production and productivity location specific suitable technology is very much important. In West Bengal, a substantial amount of land remains fallow (11.59 lakh ha) after *kharif* rice (winter rice) cultivation. Chickpea production also fluctuates year to year because of adverse weather during crop season and recorded a sharp decline over years [5]. In West Bengal chickpea was cultivated in an area of 155.1 thousand ha in 1970-71 with a productivity of 666 kg/ha which has come down to only 27.0 thousand ha with a productivity of 1185 kg/ha in 2014-15 [2]. In this context the experiment was conducted with six tillage management practices on soil microbial population.

2. MATERIALS AND METHODS

Field experiment was conducted during *rabi* season of 2016 to 2017 at the D- Block Farm, Bidhan Chandra Krishi Viswavidyalaya, Kalyani (22º96′ North latitude and 88º42′ East Longitude) to study the tillage practices and *paira* cropping on growth, yield and microbial population of chickpea under rice fallow of West Bengal. The treatments included six tillage management practices. The experiment was laid out in a randomized block design with three replications. The soil of this experimental site was clay loam with average pH level 6.5. The initial soil status of experimental soil is organic carbon (0.64%), N (322.5 kg/ha), P_2O_5 (15.5 kg/ha), K_2O (211 kg/ha) and final 0.64 %, 309.6, 18.7, 215 kg N, P_2O_5, K_2O respectively. For soil microbial count used 0.5 g soil and Erlenmeyer flask containing 50 ml of sterile agar. The standard methods were used to determine the microbial population.

3. RESULTS AND DISCUSSION

Plant height (cm)

Broadcasting seed in standing rice before 15 days of its harvest treatment recoded highest plant height (55 cm) followed by direct seeding in un-tilled field with plough (manually) (DS+PM) treatment (52 cm) at harvest and Conventional tillage (two harrowing + planking) followed by line sowing (CT+LS) treatment observed minimum plant height (47 cm). Shil *et al*. (2007) also recorded the almost same plant height of different treatments in Bari Chola-5 variety. Minimum plant height (46.45 cm) was observed in Anuradha variety in 2015-16 (Table-1).

Table 1: Effect of tillage practices on plant heights, number of Primary branch, number of pod per plant, seed index, number of plant at harvest, biological yield, economic yield and harvest index

Treatments	Plant height (cm) at harvest	Number of Primary branch	Number pod per plant	Economic Yield (kg ha^{-1})
CT+LS	47	3	58	1103
DS+PM	52	4	60	1292
DS+ZTD	48	3	56	1173
ZT/RT+LS	49	3	62	1018
BS+RT	50	3	50	953
BS+RC	55	4	68	1413
SEM (±)	**3.0**	**0.36**	**8.6**	**90.03**
CD (5%)	**8.6**	**1.0**	**24.8**	**257.2**

CT+LS = Conventional tillage (two harrowing + planking) followed by line sowing, DS+PM = Direct seeding in un-tilled field with plough (manually), DS+ZTD = Direct seeding in un-tilled field with zero till drill, ZT/RT+LS = Zero/reduced tillage (one harrowing +planking) followed by line sowing ,ZT/RT+LS = Broadcasting seed followed by reduced tillage (one harrowing + planking) (BS+RT), BS+RC = Broadcasting seed in standing rice before 15 days of its harvest (relay crop), SEM= Standard error of mean, CD= critical difference

Number of primary branch

The number of primary branch (PB) was maximum (4) in broadcasting seed in standing rice before 15 days of its harvest treatment which was at par with direct seeding in un-tilled field with plough (manually) (DS+PM) treatment followed by rest treatments (Table 1).

Pod per Plant

Maximum pod per plant (68) was recorded in broadcasting seed in standing rice before 15 days of its harvest treatment followed by Zero/reduced tillage (one harrowing +planking) followed by line sowing (ZT/RT+LS) treatment (62) and direct seeding in un-tilled field with plough (manually) (DS+PM) treatment (60). Broadcasting seed followed by reduced tillage (one harrowing + planking) (BS+RT) treatment recorded minimum (50) number of pod (Table 1) [3].

Total number of plant/m^2 at harvest

Among the tillage management practices broadcasting seed in standing rice before 15 days of its harvest (relay crop) (BS+RC) treatment recorded maximum plant stand at harvest (24 plants) which was followed by direct seeding in un-tilled field with plough (manually) (DS+PM) treatment (22 plants). The lowest plant stand (16 plants) was observed in broadcasting seed followed by reduced tillage (one harrowing + planking) (BS+RT) treatment which was also at par with zero/reduced tillage (one harrowing +planking) followed by line sowing (ZT/RT+LS) treatment [4] (Table 1).

Economic yield

Maximum yield was recorded significantly in broadcasting seed in standing rice before 15 days of its harvest (relay crop) (BS+RC) treatment (1413 kg ha^{-1}) followed by direct seeding in un-tilled field with plough (manually) (DS+PM) treatment (1292 kg ha^{-1}) (Table 1). During 2016-17 minimum (953 kg ha^{-1}) grain yield was observed in broadcasting seed followed by reduced tillage [1, 6]

Soil microbial population study

Soil microbial population was taken up at 0-15 cm soil depth under different tillage practices and *paira* cropping treatment. Beneficial bacterial count also key factor for higher production in chickpea, it facilitates better nodulation and maximum nitrogen fixation. Stacked chart showed total microbial population present in soil under different tillage management practices

and *paira* cropping treatments (Fig 1). It indicates that bacterial population was more, compare to the actinmycetes and fungi. The maximum total bacteria (245 × 10^6 CFU/g) were calculated in CT+LS treatment followed by broadcasting seed in standing rice before 15 days of its harvest (*paira* cropping) treatment (240 × 10^6 CFU/g) which was at par (Fig 2). The maximum number (106 × 10^5 CFU/g) of total actinomycetes also recorded in *relay* cropping treatment (Fig 3) and minimum number in treatment 4 (58 × 10^5 CFU/g). The minimum numbers of fungi was recorded in treatment 4 and relay cropping which is important factor for higher chickpea production (Fig 4). The maximum numbers of fungi (8 × 10^4 CFU/g) observed in treatment 3 where disease attack was more, compare to *relay* cropping treatment.

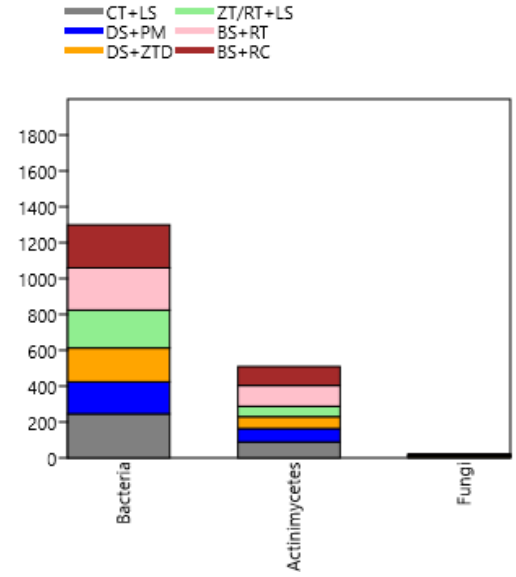

Fig. 1 Stacked chart showing microbial population (bacteria, actinomycetes and fungi) under different tillage practices

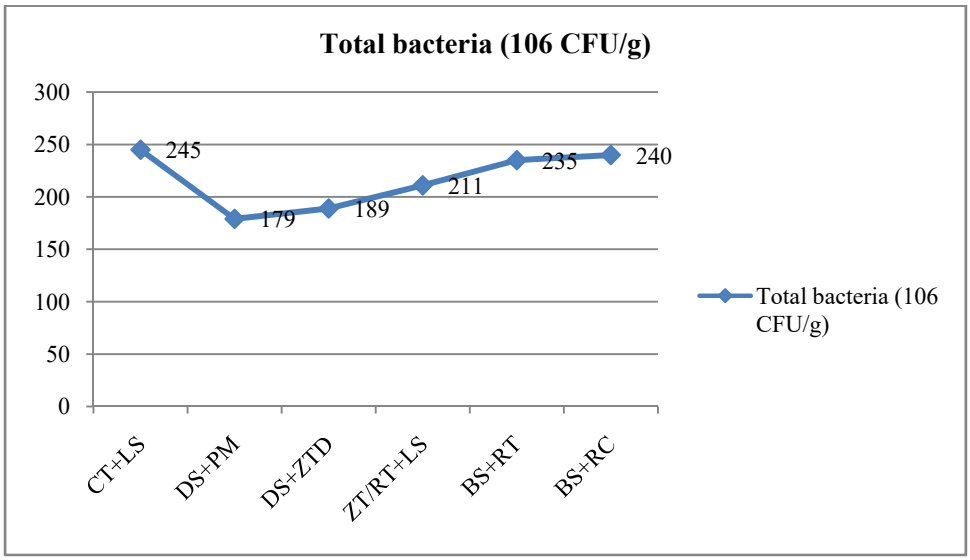

Fig. 2: Effect of different tillage practices on bacterial population

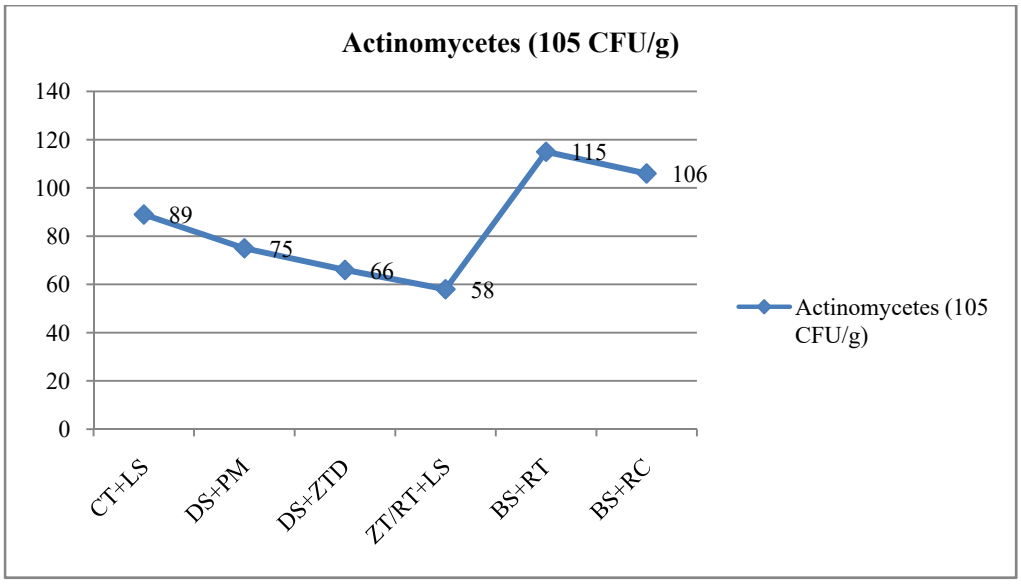

Fig. 3 Effect of different tillage practices on actinomycetes population

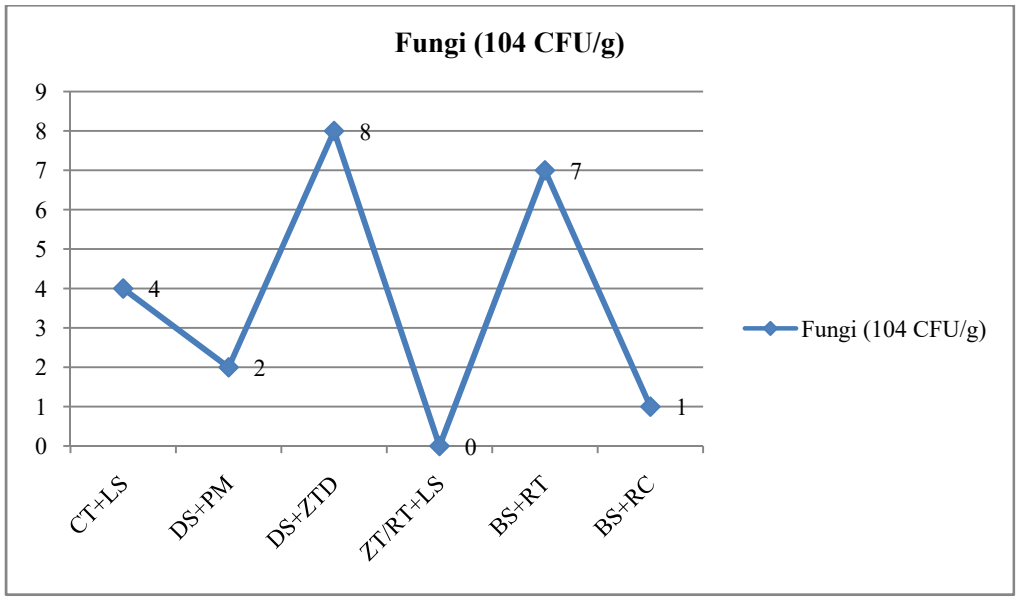

Fig. 4 Effect of different tillage practices on fungi population

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