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Evaluation of long term trial on weed dynamics in mono or double cropped rice system under different establishment methods

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Abstract
India has a wide range of agro climates and soil types. The highly diverse agriculture and farming systems are beset with different types of weed problems. Weeds reduces 10-80% crop yield, impairing, product quality and causes health and environmental hazards. Weeds are a major constraint to agriculture, forestry and aquatic environment. A field experiment was laid out at Crop Research Station, Ghaghraghat, (ANDUAT), Bahraich, U.P. to evaluate long term trial on weed dynamics in mono or double cropped rice system under different establishment methods. The treatments consisted of 3 main plots M1 – Mechanised planting/transplanting, M2 – Puddled direct seeding, M3 – Unpuddled dry direct seeding and four sub plots T1 – Weed free, T2 – Weedy check, T3 – Mechanical weeding using weeder and T4 – Chemical weed control of pre and post emergence herbicide application. NDR 359 medium duration rice variety was sown in spilt plot design with three replications. The results revealed that the grain yield loss was found 3.22% in mechanical weeding using weeder followed by chemical weed control (pre & post emergence herbicide application) 15.96%. The highest grain yield was found in weed free of M1 –Transplanting, (4.08 t/ha) followed by M2 – Puddled direct seeding (3.22t/ha). The study showed that yield of rice increased under transplanting along with mechanical weeding using weeder.

Keywords: Mechanical weeding, unpuddled dry direct seeding, weedy check, pre and post emergence herbicide application

Introduction
Rice (*Oryza sativa* L.) is the most important cereal crop of India and feeds the belly of more than 800 million Indians. It has a share of 41.39% in total food grain produced and 55% of cereals produced in the country, contributing 20-25 % to agricultural GDP (Anonymous, 2016) [2]. In India, rice is grown on nearly 43.49 m ha with total production of 104.4 mt and productivity of 2400 kg/ha (Anonymous, 2016) [2]. Cultivated area in India is 143 million ha, out of which 85 million ha (60%) is completely depends on rainfall received throughout the year. Rice (*Oryza sativa* L.) is the world's most important food crop belongs to family Poaceae. It serves as the staple food for more than half of the global population (Khan *et al*, 2013) [8]. Rice is the second most important crop which brings economic prosperity of the growers as well as earns billions of rupees through its export for country. Rice is the third highest produced cereal after wheat and maize (FAOSTAT, 2012) [4]. It is the main staple food for about 50% of the world's population, especially in developing countries (FAO, 2017) [5]. The average rainfall in India is 1194 mm per year and its intensity and distribution throughout the country is erratic (Agicultural statistics at a glance. 2011) [1]. In India, the IGP cover about 20% of the total geographical area (329 m.ha) and about 27% of the net cultivated area, and produce about 50% of the total food consumed in the country (Dhillon *et al*., 2010) [3] in India most preferred crop in India is rice, which is grown in 43 million ha. Including under rainfed and dryland agro-ecosystems. India has the low average productivity of rice, i.e., 2.3 t ha^{-1} and additionally 4 million tonnes of rice is required to satisfy the current demand. Meanwhile the production losses due to pests, diseases and weeds were increasing day by day. Rice-wheat has emerged as the most widespread crop production system in the IGP and the national rice-wheat area is estimated to be around 10 million ha. The major states in the IGP are Uttar Pradesh, Bihar, Punjab,

and Haryana.

In developing countries like India, shortage labour for agricultural work is the prominent factor that led to inefficient management practices like untimely agricultural operations resulting in yield reduction. It is therefore imperative to look for alternative methods from transplanting to direct seeding, SRI etc. (Yaduraju, N. T. & Mishra, M. 2005) [10].

India has a wide range of agro-climates and soil types. The highly diverse agriculture and farming systems are beset with different types of weed problems. Weeds cause 10-80% crop yield losses, impairing product quality and causing health and environmental hazards. Weeds are a major constraint to agriculture, forestry and aquatic environment. Crop-specific problematic weeds (such as weedy rice in rice) are emerging as a threat to cultivation, affecting crop production, product quality and farmers income. Traditionally, weed control in India has been largely dependent on manual weeding. However, increased labour scarcity and costs are encouraging farmers to adopt labour and cost saving options. The energy expended for the weeding in sometimes more than for any other single human task. During the herbicide application be careful, because the sub lethal dosage of herbicide led to ineffective weed control and sometimes total crop failure. Mechanical weed management practices through conoweeder/rotaryweeder were more helpful during the agricultural operation (Moorthy, B. T. S. & and Saha, S. 2001) [9].

Material and Methods

Experiment were conducted at Crop Research Station, (ANDUAT) Ghaghraghat, Bahraich, which is situated at Latitude (North) 27º50'N, Longitude (East) 81º20'E and Elevation (from MSL) 112m. The soil is sandy loam and low organic carbon. It is rich in potassium, medium in phosphorus and possesses good water holding capacity and pH 7.50. Study on long term trial on weed dynamics in mono or double cropped rice system under different establishment methods was conducted. The treatments consisted of 3 main plots M1 –Mechanised planting/transplanting, M2 – Puddled direct seeding, M3 – Unpuddled dry direct seeding and four sub plots T1 – Weed free, T2 – Weedy check, T3 – Mechanical weeding using weeder and T4 – Chemical weed control of pre and post emergence herbicide application. The experiment was laid out in a split plot design with three replications in $20m^2$ plot size and variety specific agronomic practices applied. Recommended dose of fertilizers are 120:60:60:25 kg N: P: K: and ZnSo4/ha. Half of the dose of N and full dose of P: K and ZnSo4 were applied as basal, while remaining N were top-dressed in 2 equal splits–at tillering and panicle initiation stage. To control weeds, Rift @ 1.25 litre/ha was applied just after transplanting and bispariybak sodium used after 25 days of transplanting/direct seeding rice. Mechanical weeding was done two times that is 25 days and 42 days after transplanting/DSR. Crop was harvested at physiological maturity and grain yield was calculated after proper sun draying (14% grain moisture). Randomly 10 hills were selected from each plot to measure the agronomic parameters that is panicle no. /m2, panicle weight (g), grain yield t/ha and weed biomass g/m2. The data on grain yield of each genotypes were recorded separately for each plot after threshing. The data show obtain were subjected to statistical analysis after necessary information (Gomez and Gomez, 1983).

Results and Discussion

Effect of different parameters on treatments

From the Table 1 and figure 1, the different treatments selected in the experiment showed the highly significant result in weed biomass. In Factor M1 – Transplanting, along with T2 – Weedy check had highest weed biomass (33.84 g/m2) as compared to T3 &T4 (28.19 & 26.59 g/m^2) respectively. The other M2 treatment had highly significant result in weed biomass in weedy check (38.45 g/m2) followed by T4-Chemical weed control pre & post emergence herbicide application (26.34g/m2) and the treatment of M3 – Unpuddled dry direct seeding weedy check (33.41 g/m2) followed by chemical weed control pre & post emergence herbicide application (31.16g/m2) and lowest weed biomass was found in T1 – Weed free of different sowing system. Weedy check had high weed biomass because there was no weed control due to water level to suppress the weed species. The grain yield of rice also showed significant result in different treatments, high grain yield was obtained from M1 – Transplanting (4.08 t/ha) followed by T3 – Mechanical weeding using weeder (3.92 t/ha), grain yield of rice had significant result.

The Factor M1 – Transplanting, T2 – Weedy check had highest panicle/m2 (162) followed by Factor T4 – Chemical weed control, pre & post emergence herbicide application (156). The other M2 treatment had highly significant result in panicle/m2 in weedy check (148) followed by Chemical weed control pre & post emergence herbicide application, (144) and the treatment of M3 – Unpuddled dry direct seeding weedy check (156) followed by T3 – Mechanical weeding using weeder (153) and lowest panicle no./m2 was found in M3, along with T4 – Chemical weed control-pre & post emergence herbicide application (84).

The Factor M1 – Transplanting, T2 – Weedy check has highest panicle weight (3.88g) followed by T3 – Mechanical weeding using weeder (3.58g). In M2 treatment highly significant result was found in panicle weight in T3-weed free (3.15g) along with T3 – Mechanical weeding using weeder, (2.96 g) followed by treatment M3 – Unpuddled dry direct seeding weed free (3.11g) along with T4 – Chemical weed control, pre & post emergence herbicide application (2.73g) and lowest panicles m/2 was found in M2, along with T2 – weed check (1.80g).

Co-relation between weed biomass and grain yield

Table 1 showed the co-relation between weed biomass and grain yield. Increase in weed biomass had negative effect on grain yield and increase in the weed biomass had shown decreasing pattern on grain yield. These two parameters showed inverse relation. Some researchers reported that weed biomass decreased and grain yield increased as crop density increased.

Yield loss by weeds

Table and figure 2 showed the co-relation between weed losses of grain yield. Highly grain yield loss was found in treatment T2 – Weedy check (46.77%) followed by T4-Chemical weed control pre & post emergence herbicide application (15.86%).

Higher grain yield was obtained from weed free plot. The major weeds found in the field were *Rotata Indica*, *Fimbristylis miliacea*, *Ageratum conyzoides*, *Cyperusiria*, *Polygonum barbatum* and *Cynadon dactylon* were found as the major weeds in all the treatments whereas, *Paspalum distichum* L., *Alternanthera sessiles* L., *Echinochloa colona* (L.), Digitaria sp., *Amischophacelus axillaris* (L.), *Echinochloa crusgalli* (L.) were minor.

Table 1: Summary of data on grain yield, yield attributes & weed parameters on evaluation of long term trial on weed dynamics in mono or double cropped rice system under different establishment methods

Main plot	Sub plot	Grain yield t/ha	Panicle no./sqm	Panicle weight (g)	Weed biomass g/m2		
					Active vegetative stage	Panicle initiation stage	Heading stage
M1 – Transplanting	T1 – Weed free	4.08	162	3.88	0.00	0.00	22.57
	T2 – Weedy check	2.63	106	2.53	2.23	3.23	33.84
	T3 – Mechanical weeding using weeder	3.92	155	3.58	2.55	2.95	28.19
	T4 – Chemical weed control (pre & post emergence herbicide application)	3.22	156	3.5	1.81	3.00	26.59
M2 – Puddled direct seeding	T1 – Weed free	3.57	148	3.15	0.00	0.00	22.06
	T2 – Weedy check	1.72	98	1.8	2.41	4.60	38.45
	T3 – Mechanical weeding using weeder	3.61	140	2.96	2.20	3.26	25.75
	T4 – Chemical weed control (pre & post emergence herbicide application)	3.12	84	2.58	2.10	3.05	26.34
M3 – Unpuddled dry direct seeding	T1 – Weed free	3.50	153	3.11	0.00	0.00	23.85
	T2 – Weedy check	1.58	144	2.23	2.42	5.24	33.41
	T3 – Mechanical weeding using weeder	3.27	156	2.65	1.69	3.93	29.68
	T4 – Chemical weed control (pre & post emergence herbicide application)	3.06	147	2.73	1.98	4.26	31.16
Mean of Factor-1	1	3.46	145	3.37	2.20	3.60	27.80
	2	3.00	133	2.62	2.24	3.64	26.65
	3	2.85	135	2.68	2.04	4.47	29.52
	CD (0.05%)	NS	NS	0.17	NS	0.27	NS
Mean of Factor-2	1	3.72	155	3.38	0.00	0.00	22.83
	2	1.96	96	2.19	2.36	4.36	35.23
	3	3.60	149	3.06	2.15	3.38	27.87
	4	3.13	149	2.94	1.97	3.44	28.69
	CD (0.05%)	0.34	12	0.27	0.20	0.33	3.51
Interaction	M and T	0.58	NS	NS	NS	NS	NS
	T and M	0.52	NS	NS	NS	NS	NS

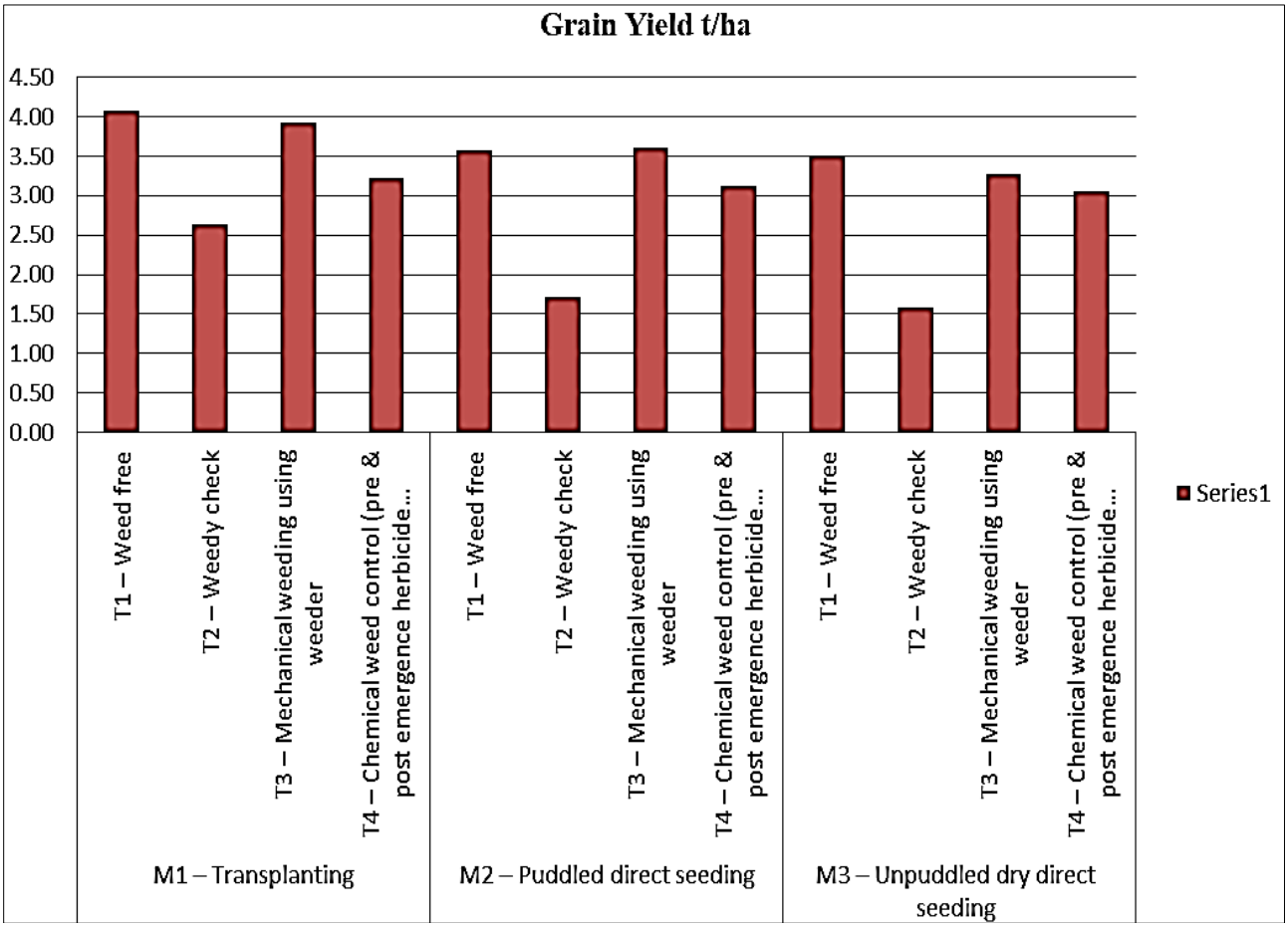

Fig 1: Grain yield t/ha at all the treatments

Table 2: Grain yield losses of weed

Main plot	Sub plots	Grain yield loss %
	T1 – Weed free	—
	T2 – Weedy check	46.77
	T3 – Mechanical weeding using weeder	3.22
	T4 – Chemical weed control (pre & post emergence herbicide application)	15.86

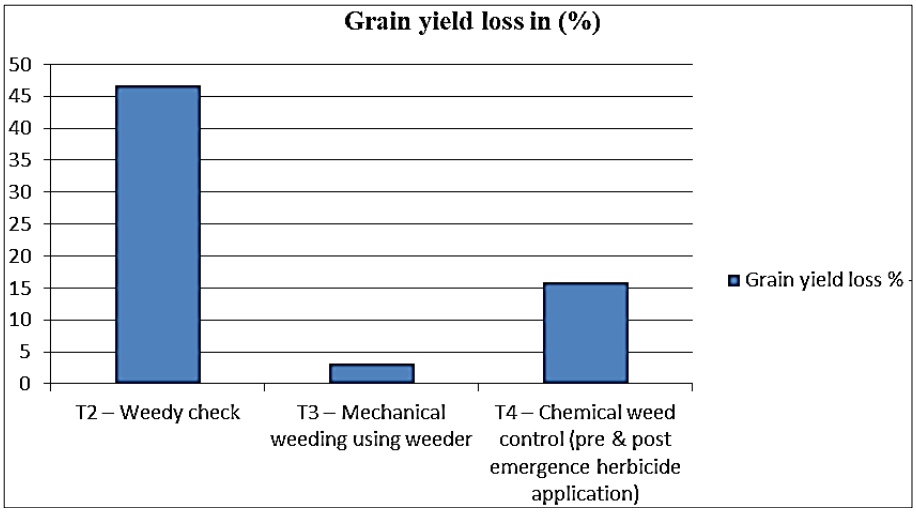

Fig 2: Grain yield losses at all the treatments

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