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Tillage and weeding effect on performances of direct sown *Autumn* rice (*Oriza sativa* L.)

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ABSTRACT

An on-farm field experiment was conducted to assess the effect of different tillage and weeding operations on performances of direct sown *autumn* rice (*Oriza sativa* L.) during 2011 and 2012. Results revealed that the density and dry matter weight of weeds at 20 and 40 days after sowing were significantly affected by different treatment combinations. The treatment of pre-monsoon ploughing twice by MB plough + rototilling twice + chemical weeding by Butachlor showed the highest number of effective tillers/m^2 and grains/panicle in case direct seeded *autumn* rice. However, the effect of different treatment combinations on 1000 grains weight was non-significant both during 2011 and 2012. Significantly highest grain (2.64 and 2.71 t/ ha during 2011 and 2012, respectively) and straw yields (7.12 and 7.89 t/ ha during 2011 and 2012, respectively) were recorded from the plot receiving pre-monsoon ploughing twice by MB plough + rototilling twice + chemical weeding by Butachlor 50EC (as pre- emergence @ 2 kg *a.i.* per ha) over the plot receiving Farmer's practice method. The B: C ratio was also highest in this treatment during both the years of experimentations.

***Key words*:** Tillage, weeds density, biomass, control, yield, direct seeded upland rice.

Introduction

Rice dominates the agriculture scenario in Assam of north-east region of India. In Assam, rice is cultivated in a wide range of environmental situations *i.e.* Autumn (*Ahu*), Winter (*Sali*), Summer (*Boro*) and Deep water (*Bao*) rice. Rice is cultivated in 2679 thousand hectare area of Assam, where *autumn* rice covers about 464 thousand hectare. However, because of many biotic and abiotic constraints the productivity of *autumn* rice is low.

Weeds are one of the major problems during *autumn* season causing substantial yield losses in upland rice under Assam conditions. The warm temperature and high humidity conditions favour year round luxuriant growth of almost all weed species (De Datta, 1981). Under direct sown condition, weeds pose serious competition to the crop in the early stage and cause heavy reduction in yield. In case of direct seeded rice also, the rice seedlings compete with different weed species from their emergence and this may lead to reduction in yield up to 97% (Saxena and Vaishya, 1993). Uncontrolled weeds resulted in about 80% reduction in grain yield and sometimes result in complete failure of crop of direct seeded rice (Pandey *et al.*, 2000; Gopinath and Kundu, 2008). Thus, due to high weed pressure, weed management in direct seeded rice has been a huge challenge for the researchers and farmers as well.

The conventional method of weed control (hoeing or hand weeding) is laborious, expensive, time consuming and sometime causes damages to crop. It has been estimated that 150 to 200-labour-day/ ha are required to keep rice crop free of weeds (Trung *et al.*, 1995; Roder, 2001). In addition, manual weeding is often not done on time owing to adverse soil and weather conditions. Chemical weed control certainly has its merits over such existing methods, but extensive use of chemical herbicides alone had deleterious effect on environment and productivity status of soil. Besides, tillage operations also suppressed weed growth (Janiya and Moody, 1982). The methods of land preparation influence the germination of weeds (Sindhu *et al.*, 2011). Thus, physical manipulations of soil with the help of tools and implements not only kill the weeds but also placed the weed's seeds deep inside the soil which are often unable to germinate.

An appropriate strategy therefore is needed to avoid high weed infestations and to prevent unacceptable competition with crop. Work conducted at CRRI, Cuttack indicated that appropriate land preparation can be effectively used in integrated weed management systems (Moorthy, 1992). Integration of chemical plus hand weeding along with proper tillage operations offers economically suitable alternatives for cultivations of crops. Thus, proper land preparations in combination with timely weed control measures are of vital importance in case of upland *autumn* rice for getting higher yield. There is a need to identify proper tillage practices that can perform better weed control under unpuddled environment. Henceforth, the present investigation was carried out to study the effect of different tillage practices in combination with weeding operations on yield and yield attributes of direct sown *autumn* rice under rainfed condition of Assam of north-east region of India.

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Materials And Methods

The present field experiment was carried out during *autumn* season (March/April to June/July) for two consecutive years *viz*. 2011 and 2012 in upland condition of Kakodonga watershed of Titabar Agricultural sub-division, Jorhat district, Assam (located in latitude 26.55′N, longitude 90°00′E and altitude 48.12m). The climate of the study area is humid subtropical with an average annual rainfall of 2000mm, most of which was recorded in the rainy season. Mean maximum and minimum annual temperatures recorded were 27.5°C and 17.2°C, respectively. Lowest temperature was recorded in January, while the highest temperature in June. The soils of the experimental site were sandy loam in texture (containing 48.29, 30.90 and 20.81% sand, silt and clay respectively) with bulk density 1.23 mg/m^3, water holding capacity 35.95%, soil pH 5.4, organic carbon 0.87%, available nitrogen 385.77 kg/ha, available phosphorous 24.21 kg/ha and available potassium 238.14 kg/ha.

Four treatment combinations *viz.* T_1= Six times ploughing by wooden country plough (Farmer's practice), T_2= Pre-monsoon ploughing by MB plough Twice + rototilling twice, T_3= T_2 + Hand weeding twice and T_4= T_2 + Butachlor were tested in a Randomized Block Design (RBD) replicating six times. The individual plot size was 20 × 20 sq.m. A direct seeded *autumn* rice variety Luit (100 days) was selected for the experiment and sowing was done during first week of April in both the years. The seeds were sown (@75 kg/ha) in lines at a spacing of 20 cm. The total rainfalls during early stage of the crop were 495.8 mm (total 22 rainy days) and 356.4 mm (total 16 rainy days) during 2011 and 2012 respectively. The recommended dose of fertilizers *i.e.* 40 kg N, 20 kg P_2O_5 and 20 kg K_2O per hectare was applied in the form of Urea, Single Super Phosphate (SSP) and Murate of Potash (MOP), respectively. The Urea and MOP were applied in two equal halves *viz.* after first hand weeding (20 days after sowing) and after second hand weeding (40 days after sowing). The whole amount of SSP was applied at the time of final ploughing. The pre-emergence herbicide Butachlor (2 kg *a.i.*/ ha) was applied one day after sowing with a manually operated knapsack sprayer delivering a spray volume of 600 liters/ ha through flat fan nozzle. All other agronomic practices were followed as per recommendation for the crop under agro-climatic situation of Assam, India.

Data on weed density and biomass were recorded at 20 and 40 days after sowing (DAS) in each plot in a quadrant measuring 1 m^2. Weeds were counted and were removed for recording their biomass. Weed samples were sun-dried and later oven dried at 70°C until constant weight was attained. The data on yield and yield attributing parameters were recorded at the harvesting time of the crop. Crop was manually harvested during the second week of July for both the years. All collected data were subjected to statistical analysis as per the procedure outlined by Gomez and Gomez (1984). The cost: benefit ratio was calculated on the basis of the local market prices of the commodities prevailing during 2011 and 2012.

Results And Discussion

Effect on weeds:

The weed-rice ecological relationship is very complex and dynamic. In case of upland direct seeded *autumn* rice, different types of weeds were found in the field under the climatic condition of Assam. The prominent weed flora observed in the experimental field included grasses (*Cynodon dactylon, Echinochloa colonum, Digitaria violacea, Eleusine indica* and *Echinochloa crusgalli*), sedges (*Cyperus rotundus, Fimbristylis miliacea, Mimosa pudica, Cyperus difformis*) and broad leaved weeds (*Centella asiatica, Commelina benghalensis, Amaranthus viridis, Polygonum hydropiper, Ageratum conyzoides, Borreria hispida* and *Eclipta alba*).

The results revealed that weed population and biomass of weeds were significantly influenced by different treatment combinations. The effect of different tillage and weeding operations on density of weeds in directed seeded *autumn* rice is presented in the Figure 1. The weed density at 20 days after sowing (DAS) was varied from 15.38- 26.24 and 12.93- 23.74 nos./ m^2 during 2011 and 2012, respectively. The highest weed density was recorded in the treatment involving six times ploughing by wooden country plough (*i.e.* Farmer's practice) which was at par with the treatment of pre-monsoon ploughing twice by MB plough + rototilling twice (T_2). The lowest density of weeds was recorded in the treatment of pre-monsoon ploughing twice by MB plough + rototilling twice + Butachlor (*i.e.* T_4) which showed 41.39 and 45.53% reduction in weed populations respectively during 2011 and 2012 at 20 DAS over farmer's practice method. At 40 DAS, the weed population per square meter measurements varied from 32.60-60.00 and 24.16- 58.30 nos./ m^2 during 2011 and 2012, respectively. Pre-monsoon ploughing twice by MB plough + rototilling twice along with chemical weeding by Butachlor 50EC as pre- emergence @ 2 kg *a.i.*/ ha showed the lowest population of weeds both during 2011 and 2012. It has been reported that shallow tillage before crop emergence and post plant tillage after crop establishment help in removing annual weeds and inhibits the growth of perennial weeds (Buhler, 2002). On the other hand, T_2 treatment (*i.e.* pre-monsoon ploughing twice by MB plough + rototilling twice) showed the highest weed density followed by T_1 treatment (*i.e.* six times ploughing by wooden country plough).

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Significant variations were also observed in dry weight of weeds due to different tillage and weeding operations in case of directed seeded *autumn* rice (Figure 2). The highest dry weed biomass at 20DAS was recorded from the treatment where farmer's practice (T_1) was carried out. However, at 40DAS weed biomass was highest in case of the treatment receiving pre-monsoon ploughing twice by MB plough + rototilling twice (T_2). Pre-monsoon ploughing twice by MB plough + rototilling twice + Butachlor (*i.e.* T_4 treatment) showed the lowest dry weight of weeds both during 2011 and 2012. These results indicated that pre-emergence application of herbicides remarkably reduced the total population and biomass of weeds during entire growth period of the crop. Gopinath *et al.* (2012) also reported that Butachlor application coupled with mechanical weeding (40 DAS) gave a weed control efficiency of 80-86% in case of direct-seeded rice. Application of pre-emergence herbicides (like Butachlor) has been found to control weeds satisfactorily in direct seeded rice (Moorthy and Manna, 1993; Pellerin and Webster, 2004). Integrated approaches suggested for sustainable weed control in direct seeded rice also included the use of herbicides followed by manual weeding and rouging operations (Abdul *et al.*, 2013).

Effect on crop growth and yield:

The effect of tillage and weeding operations on growth and yield of direct seeded *autumn* rice are presented in Table 1. Data revealed that pre-monsoon ploughing twice by MB plough + rototilling twice + chemical weeding by Butachlor resulted in the highest numbers of effective tillers/ m^2 (239.80 and 316.00 during the year 2011 and 2012, respectively). This was followed by the T_1 treatment receiving six times ploughing by wooden country plough (*i.e.* Farmer's practice). In both 2011 and 2012, the lowest effective tillers/ m^2 were recorded in the treatment that included pre-monsoon ploughing twice by MB plough + rototilling twice (*i.e.* T_2).

The numbers of grains/ panicle were also significantly affected by different treatment combinations under investigation and data varied from 49.40- 81.10 and 54.40- 81.34 during 2011 and 2012, respectively. Pre-monsoon ploughing twice by MB plough + rototilling twice + Butachlor *i.e.* T_4 treatment showed the highest numbers of grains/ panicle in case of directed seeded *autumn* , followed by pre-monsoon ploughing twice by MB plough + rototilling twice + hand weeding twice *i.e.* T_3 treatment. On the other hand, the integration of different tillage and weeding operations had a non-significant effect on 1000 grains weight of rice during both the years of experimentation (Table 1).

In the present investigation, the grain yield (t/ha) measurements varied between 1.51 and 2.64 during 2011 and 1.85 and 2.71 during 2012 (Table 1). Significantly highest grain yield was recorded from the plot receiving pre-monsoon ploughing twice by MB plough + rototilling twice + Butachlor (*i.e.* T_4 treatment) during both the years of experimentations. This T_4 treatment gave 74.54 and 46.37% more grain yield over Farmer's practice (T_1) method during 2011 and 2012, respectively. Increase in grain yield in case of T_4 treatment may be attributed to effective control of weeds (Fig. 1 and 2) and marked improvement in growth and yield attributes (Table 1). Yadav *et al.* (2008) also found highest yield of rice by application of herbicides plus two hand weeding in direct seeding rice in eastern Uttar Pradesh of India.

The data on straw yield varied from 5.32-7.12 and 5.44-7.89 t/ha during 2011 and 2012, respectively. Highest straw yield was recorded in T_4 and lowest was recorded in case of T_2 treatment (Table 1). Data also revealed that the yield of rice was more during second year than during the first year which might be due to lower incidence of weeds during the second year crop.

Table 1: Yield, yield attributes and cost: benefit of direct sown *autumn* rice as affected by different tillage and weeding operations.

Treatments	Number of Effective tillers/m^2		Number of Grains/ panicle		1000 grain weight (gm)		Grain yield (t/ha)		Straw yield (t/ha)		B: C ratio	
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
T_1: Six times ploughing by wooden country plough (Farmer's practice)	219.75	225.75	58.20	63.57	24.93	25.60	1.51	1.85	5.83	6.38	1.27	1.31
T_2: Pre-monsoon ploughing by MB plough Twice + rototilling twice	192.20	220.00	49.40	54.40	23.90	24.21	1.75	1.91	5.32	5.44	1.43	1-56
T_3: T_2 + Hand weeding twice	209.90	244.50	64.38	73.00	25.43	25.78	2.25	2.09	5.90	7.34	1.65	1.59
T_4: T_2 + Butachlor	239.80	316.00	81.10	81.34	25.73	24.53	2.64	2.71	7.12	7.89	1.89	1.97
S.Ed (±)	-	17.05	2.13	3.85	-	-	4.73	3.72	6.19	1.43	-	-
C.D (P= 0.05)	NS	37.15	5.36	8.38	NS	NS	10.30	8.10	13.49	3.11		

NS: Non significant;
B: C ratio: Benefit: Cost ratio

Benefit: Cost Ratio:

The highest benefit: cost (B: C) ratio 2.19 and 2.48 were recorded in case of T_4 treatment (*i.e.* pre-monsoon ploughing twice by MB plough + rototilling twice + Butachlor) during 2011 and 2012, respectively. This might be due to the fact that efficient tillage and weeding operations lead to proper controlling of weeds and ultimately resulting in higher yield of crop. Gopinath *et al.* (2012) also reported that herbicidal use gave higher B: C ratio as compared to other weed control methods in case of rice cultivation. The B: C ratio was lowest in case of the treatment receiving pre- monsoon ploughing twice by MB plough + rototilling twice.

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Over all, it is concluded that integrated tillage and weeding operation involving pre-monsoon ploughing twice by MB plough + rototilling twice + chemical weeding by Butachlor 50EC as pre- emergence @ 2 kg *a.i.*/ ha was most effective in terms of weed control efficiency, higher yield and economic returns in case of direct seeded *autumn* rice under the climatic condition of Assam of north-east region of India.

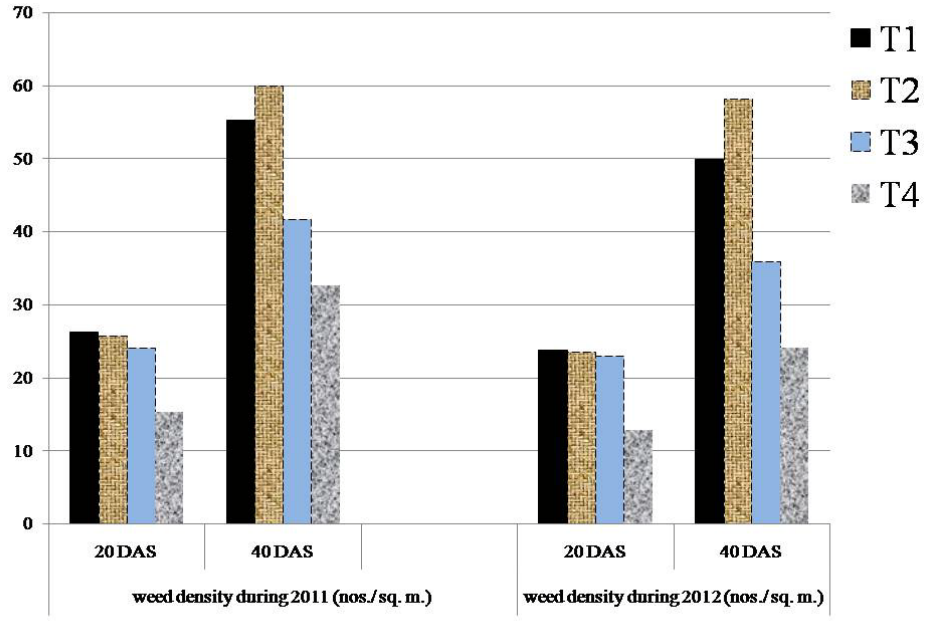

Fig. 1: Effect of different tillage and weeding operations on density of weeds (numbers per meter square) during 2011 and 2012.
(T_1= Six times ploughing by wooden country plough (Farmer's practice), T_2= Pre-monsoon ploughing by MB plough Twice + rototilling twice, T_3= T_2 + Hand weeding twice and T_4= T_2 + Butachlor)

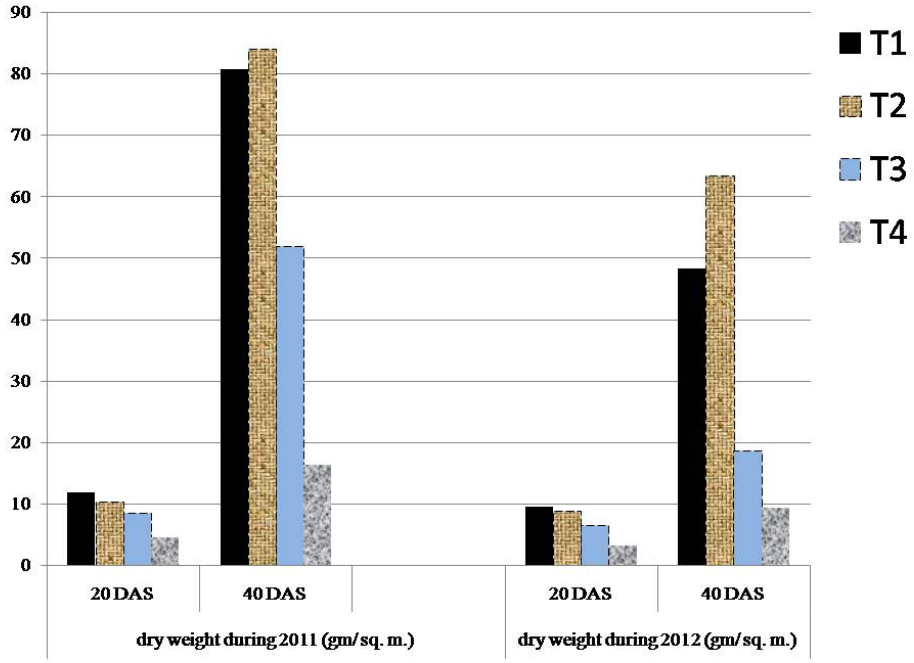

Fig. 2: Dry weight (gm per meter square) of weeds as affected by different tillage and weeding operations during 2011 and 2012.
(T_1= Six times ploughing by wooden country plough (Farmer's practice), T_2= Pre-monsoon ploughing by MB plough Twice + rototilling twice, T_3= T_2 + Hand weeding twice and T_4= T_2 + Butachlor)

References

Abdul, S.J., K. Uddin, P. Anwar, M.T.M. Mohamed, M.R. Ismail and A. Man, 2013. Sustainable weed management in direct seeded rice culture: A review. Australian J. Crop Sci., 7(7): 989-1002.

Buhler, D.D., 2002. Challenges and opportunities for integrated weed management. Weed Sci., 50: 273-280.

De. Datta, S.K., 1981. Weeds and weed control in rice. In: Principles and Practices of Rice. John Wiley and Sons, New York, pp: 460-512.

Gomez, K.A. and A.A. Gomez, 1984. Statistical Procedures for Agricultural Research. Second Ed., Wiely Interscience Publ. John Willy and Sons, New York.

Gopinath, K.A. and S. Kundu, 2008. Evaluation of metsulfuron-methyl + chlorimuron-ethyl for weed control in direct seeded rice (*Oryza sativa*). Indian J. Agric. Sci., 78(5): 466-69.

Gopinath, K.A., B.L. Mina, K.P. Singh and K.C. Nataraja, 2012. Integrated weed management in direct-seeded rainfed rice (*Oryza sativa*). Indian J. Agron., 57(3): 245-249.

Janiya, J.D. and K. Moody, 1982. Weed control in transplanted rice (*Oryza sativa*) grown under different moisture regimes. Philippines J. Weed Sci., 9: 29-35.

Moorthy, B.T.S. and G.B. Manna, 1993. Studies on weed control in direct seeded upland rainfed rice. Indian J. Agric. Res., 27:175-180.

Moorthy, B.T.S., 1992. Effect of methods of land preparation and herbicide use on weed control and crop performances of rainfed upland rice. Indian J. Agric. Sci., 62(6): 382-386.

Pandey, A.K., V. Prakash, P. Singh, K. Prasad, R.D. Singh and V.P. Mani, 2000. Weed management in major crops of North-western Himalayas. Technical Bulletin, 16, VPKAS, Almora, pp: 66.

Pellerin, K.J. and E.P. Webster, 2004. Imazethapyr at different rates and times in drill and water seeded imidazolinone-tolerant rice. Weed Technol., 18: 223-227.

Roder, W., 2001. Slash-and-burn rice systems in the hills of northern Lao PDR. In: Description, challenges, and Opportunities, IRRI, Los Banos, Philippines, pp: 201.

Saxena, Amal and R.D. Vaishya, 1993. Effect of methods of weed control on the yield of upland drilled rice and associated weeds. Proceedings of International Symposium, Indian Society of Weed Science, held at Hisar during 18-20.

Sindhu, P.V., C.G. Thomas and C.T. Abraham, 2011. Stale seedbed and green manuring as an effective weed management strategy in dry-seeded rice (*Oryza sativa*). Indian J. Agron., 56(2): 109-115.

Trung, H.M., N.T. Tan and H.A. Cung, 1995. Present status and prospect of weed control in rice in Vietnam. In: Proceeding of the 5th Asian-pacific Weed Science Society Conference, Tsukuba, Japan., p: 601-606.

Yadav, D.S., Sushant, A.M. Mortimer and D.E. Johnson, 2008. Studies on direct seeding of rice, weed control, and tillage practices in the rice-wheat cropping system in eastern Uttar Pradesh. In: Direct Seeding of Rice and Weed Management in the Irrigated Rice-Wheat Cropping System of the Indo-Gangetic Plains (Eds. Y. Singh, V.P. Singh, B. Chauhan, A. Orr, A.M. Mortimer, D.E. Johnson and B. Hardy). IRRI, Metro Manila, Philippines. P: 131-138.