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Research article

EFFICACY OF DIFFERENT ESTABLISHMENT METHODS AND WEED MANAGEMENT PRACTICES ON WEED DENSITY, WEED DRY MATTER, WEED CONTROL EFFICIENCY AND YIELD UNDER RAINFED LOWLAND RICE

ArunbabuTalla[a*] and Satya Nanda Jena[b]

[a,b]Department of Agronomy, College of Agriculture, Orissa University of Agriculture and Technology, Bhubaneswar-751003
*Corresponding author, e-mail: arunbabu.thalla@gmail.com

ABSTRACT: A field experiment was conducted during the *kharif* season of 2011-12 at Agronomy Research Farm, Central Research Station, Orissa University of Agriculture and Technology, Bhubaneswar. The experiment was laid out in split-plot design to find out the effect of various establishment methods and weed management practices on different weed parameters such as weed density (Grasses, Sedges and Broadleaf weeds), weed dry matter, weed control efficiency and grain yield under rainfed lowland rice. Experiment resulted that Weed parameters like total weed density (8.0 no. m^{-2}), weed dry matter (6.4g.m^{-2}) and weed index were lowest in system of rice intensification (SRI) at 30 days after transplanting/sowing (DAT/S). With respect to weed management practices total weed density (7.53 no.m^{-2}),weed dry matter (2.3 g m^{-2}) was recorded lowest in pyrazosulfuron-ethyl @20 g.ha- and highest weed control efficiency 97.04 percent were recorded in conoweeder. Grain yield of 5.02 t ha-1 and 4.76 t ha-1 were recorded in SRI and conoweeder respectively. While highest straw yields were recorded in SRI (5.8 t ha^{-1}) and conoweder (5.5 t ha-1). Severe infestation of weeds reduced the yield by 32, 38, 39 and 52 percent in transplanted, SRI, drum seeded and direct seeded rice.
Keywords: Rice, Crop establishment methods, Weeds, Weed management practices.

INTRODUCTION

Rice is the major food crop in the tropics in Asian countries and India in particular. Ninety per cent of the world's rice is produced and consumed in Asia [1]. India occupies a premier position both in terms of area and production of rice in the world. It has the largest area of around 42.6 million hectare with a production of 95.3 million tonnes of rice with average yield, 2240 kg ha^{-1} during 2010-2011[2]. But national average yield of rice in India is far behind the world's average yield. With the present growth trends, the country will have to feed about 130 billion mouths in the year 2021 requiring production of 5 to 6 million tonnes of additional food grains per year [3].It is estimated that by 2020 at least 170-180 m t (115-120 m t milled rice) of rice to be produced in India with an average productivity of 4.03 t/ha to maintain the present level of self-sufficiency [4]. The one way to meet the requirement is through eliminating the loss caused by the weeds.The extent of yield reduction due to weed infestation varies from 35 to 72 percent in rice grown under transplanted condition [5]. So, There is a need to reduce the weed competition in direct seeded, transplanting and SRI rice starting from crop emergence up to harvest and to develop a cost effective weed management techniques. Unchecked weed growth caused 53% reduction in grain yield in puddled conditions, and 91% yield reduction in non-puddled conditions [6].The share of the herbicide to total pesticide consumption is 16 percent and proper usage and dose and time of application is critical in effective weed control and for raising healthy crop. Manual and mechanical weeding (conoweeding and rotary weeding) are effective, time consuming and the manual weeding is not possible due to unfavorable weather condition and shortage of man power during critical period of agricultural operation [7].Keeping in view the above points, the present investigation is to determine the efficacy of chemical, mechanical and manual weed management practices in different rice establishment methods.

MATERIALS AND METHODS

The field experiment was laid out in split-plot design with sixteen treatments with respect of its four main plots and four subplots during the *kharif* season 2011-12 at Agronomy Research Farm, Central Research Station, Orissa University of Agriculture and Technology, Bhubaneswar. The main plots contain four different methods of rice establishment *i.e.* M_1 (System of rice intensification-SRI), M_2 (Transplanting), M_3 (Line sowing) dry seeding and M_4 (Drum seeding) and the subplots contain four different type of weed management practices i.e. W_1 (Pyrazosulfuron–ethyl @20 g ha^{-1}), W_2 (Conoweeding), W_3 (Two hand weeding) and W_4 (weedy check) which were replicated thrice. "Pratikshya-ORS-201-5 (140 d)" was grown as the test variety of rice. The soil of the experimental site was sandy loam in texture with acidic pH 5.45, EC(0.14 ds m^{-1}), medium in organic carbon (0.64%), low in available nitrogen(174.58 kg ha-1), but high in available phosphorus (40.626 kg ha^{-1}) and high in available potassium (312.54 kg ha^{-1}). Recommended agronomic practices, plant protection measures and formulae were followed. Species wise weed density by quadrate of size 0.50 m2 per plot was taken at periodical intervals and those are categorized into Grasses, Broadleaf and Sedges. Total and group wise population was expressed as individuals per m2. This cultivar has critical weed competition 30 DAS/T, so the weed parameters presented in table.1 and table.2 at 30 DAS/T. The categorized weed samples and brought in paper bags for air drying, shade dried initially followed by oven drying at 80^0C for 24 hours and determining its dry matter to attain constant weight and expressed in g m^{-2}.Weed control efficiency (WCE) and weed index was calculated based on the weed dry matter and grain yield respectively.

RESULTS AND DISCUSSION

The experimental plots was dominated with grasses like *Echinochloacolona, Setariaglauca, Panicumrepens,, Echinochloacrusgalli, Paspalumscorbiculatum,*; broad leaf weeds like *Alternantherasessilis, Ludwigiaparviflora, Eclipta alba, Marsiliaquadrifolia,, Cyanotiscuculata* in fested the crop from early period till harvest . *Cyperusiria, Cyperus difformis, Fimbristylis miliaceae* were the dominant sedges observed. All these weeds were predominant in puddled and anaerobic condition because they can tolerate and flourish easily under submerged conditions as that of paddy [8] also reported similar weed flora under puddled condition.

Weed Density

The data shown with respect of grasses, broad leaf weeds and sedges in table.1 has revealed that those individual weed densities are recorded lowest in system rice intensification which was statistically at par with remaining establishment methods. With respect to the weed management practices, individual lower weed densities are recorded significantly in pyrazosulfuron-ethyl @20 g ha^{-1} followed by conoweeding, hand weeding twice and control.

Table-1: Individual and total weed density (no.m^{-2}) as affected by crop establishment methods and weed management practices in rice.

Treatment	Grasses (no.m^{-2})	Broad leaved weeds (no.m^{-2})	Sedges (no.m^{-2})	Totalweed density(no.m^{-2})
CROP ESTABLISHMENT METHOD (M)				
M_1:SRI	4.5(21.25)	6.1(38.21)	2.8(8.84)	8.0(65)
M_2:Transplanting	5.1(27.01)	6.7(45.89)	3.6(13.96)	9.1(83.81)
M_3:Line sowing (dry seeding)	6.0(37)	7.9(63.41)	4.6(22.16)	10.3(107.09)
M_4:Drumseeding	5.8(34.64)	7.7(60.29)	4.2(18.64)	10.4(109.16)
SE(m)±	0.32	0.41	0.42	0.28
CD(p=0.05)	1.20	1.52	1.34	0.93
WEED MANAGEMENT PRACTICES(W)				
W_1: Pyrazosulfuron-ethyl@20g ha^{-1}	4.2(18.64)	5.7(33.49)	3.0(10)	7.5(57.25)
W_2: Conoweeder	4.5(21.25)	6.2(39.44)	2.9(9.41)	8.1(66.61)
W_3:Hand weeding twice	6.1(38.21)	7.5(57.25)	4.3(19.49)	104(109.16)
W_4 : Weedy check	6.4(41.96)	8.8(78.44)	4.8(24.04)	11.4(130.96)
SE(m)±	0.34	0.41	0.34	0.34
CD(p=0.05)	0.94	1.34	0.92	0.81

The data was subjected to square root transformation. $\sqrt{X+1}$ the figures in parentheses are the original values.

The data pertaining to total weed density (no.m^{-2}) recorded at 30DAT/S is presented in table 1. The data revealed that weed density was significantly influenced by crop establishment methods and weed management practices. Total weed density was significantly the lowest with System of Rice Intensification (SRI) over remaining crop establishment methods. Significantly lower weed density was recorded with pyrazosulfuron-ethyl@20g ha^{-1} over remaining weed remaining practices. Puddling operation that inhibited the germination of weed seeds and destroyed most of the weed under anaerobic condition, which might have reduced weeds density under Puddled condition.Similar results were also reported [9].Among different weed management practices significantly lower weed density was recorded with pyrazosulfuron-ethyl @20g.ha^{-1} and conoweeding method. This revealed that pyrazosulfuron –ethyl had prolonged effect on controlling weeds and continuous killing of weeds by conoweeding. Similar results were observed by various researchers [10].

Weed Dry Matter

Data related to total weed dry matter accumulation (g m^{-2}) are presented in table 2. The minimum weed dry matter observed with SRI method was significantly lower than that of transplanting, line sowing and drum seeding methods throughout the growth period. Weed dry matter recorded in drum seeding (7.0g m^{-2}) was significantly higher than that of other methods. The lowest weed dry matter with pyrazosulfuron-ethyl@20g.ha^{-1} (2.3g m^{-2}) over rest of the treatments. However the difference in weed dry matter between conoweeder, hand weeding twice and weedy check methods were not significantthroughout the growth period. The lower weed dry matter recorded with SRI might be due to puddling and anaerobic conditions prevailed in field which might have reduced the weed dry matter also. Similarly, as experiment was carried on anaerobic soil that might have reduced the weed problem considerably when compared to where sowing was done in aerobic conditions. Earlier Singh *et al.* (2003) and Singh *et al.* (2004) also reported similar observations.

Weed Control Efficiency

Data on weed control efficiency (per cent) are presented in table 2. The highest weed control efficiency was recorded with conoweeding (95.3 per cent) and it was significantly superior to all other treatments. Among the other weed control treatments, higher weed control efficiency was observed with Pyrazosuluron-ethyl@20g ha^{-1}(84.0 per cent) followed by hand weeding twice (83.5 per cent) Results were akin with the results reported [8].

Table-2: Total weed dry matter (gm^{-2}), weed control efficiency (%), weed index and yield as affected by crop establishment methods and weed management practices in rice.

Treatment	Total weed dry matter (g.m^{-2})	Weed control efficiency (%)	Grain yield (t ha^{-1})	Straw yield(t ha^{-1})
Crop Establishment Method (M)				
M_1:SRI	6.4(41.96)	8.2(68.24)	5.02	5.85
M_2:Transplanting	6.6(44.56)	8.2(68.24)	4.36	5.41
M_3:Line sowing (dryseeding)	6.9(48.61)	8.1(66.61)	2.95	3.62
M_4:Drumseeding	7.0(50)	8.1(66.61)	4.05	4.98
SE(m)±	0.001	0.008	0.11	0.03
CD(p=0.05)	0.003	0.02	0.37	0.12
Weed Management Practices (W)				
W_1: Pyrazosulfuron-ethyl@20g ha^{-1}	2.3(6.29)	9.2(85.64)	4.18	4.87
W_2: Conoweeder	2.6(7.76)	9.8(97.04)	4.77	5.57
W_3:Hand weeding twice	4.7(23.09)	9.1(83.81)	4.54	5.44
W_4 : Weedy check	11.4(130.96)	1(0)	2.88	3.97
SE(m)±	0.001	0.01	0.14	0.03
CD (p=0.05)	0.004	0.02	0.40	0.10

The data was subjected to square root transformation. √X+1 the figures in parentheses are the original values

Weed Index

The weed index is the per cent reduction in crop yield due to presence of weeds in comparison with weedy. The lowest weed index was recorded with SRI method (2.3 per cent) and it was significantly superior than remaining methods of establishments. In the other words, SRI and transplanting was found to be the next best option. The lower weed index recorded in the weed management practices conoweeding followed by pyrazosulfuron-ethyl@ 20g/ha and hand weeding twice, this might be due to the fact that the initial and the later germinated weeds were controlled by conoweeder. This might be due to the fact that the initial and the later germinated weeds were controlled by conoweeder.

Grain Yield

Data related to grain yield shown in table.2 that significantly highest grain yield was recorded with SRI (5.018 t ha^{-1}) followed by transplanting. Among the weed management practices, conoweeding (4.76 $t.ha^{-1}$) was found to be significantly superior to rest of the treatments.

Straw Yield

The highest straw yield was recorded with SRI (5.85$t.ha^{-1}$) followed by transplanting (5.41 t. ha^{-1}) while least was recorded with dry seeding (3.62 t. ha^{-1}). Among the weed control treatments, the highest straw yields was recorded with conoweeding (5.57 t. ha-1) and found superior to rest of the treatments. Two hand weeding (5.44 $t.ha^{-1}$), followed by pyrazosulfuron –ethyl @20g/ha (4.87 $t.ha^{-1}$) were remained statistically comparable but differed significantly with weedy check (3.97$t.ha^{-1}$). This might be due to maintenance of weed free environment at critical stages of crop growth, which lead to complete utilization of nutrients and other growth factors by crop plants, resulting in vigorous growth and greater dry matter accumulation by crop, especially under transplanting conditions.

CONCLUSION

Weed parameters such as individual weed density of different types of weeds, weed dry matter, weed control efficiency and weed index has recorded that lowest in system of rice intensification which was statistically at par with remaining crop establishment methods. With respect of weed management practices lowest in pyrazosulfuron-ethyl @ 20 $g.ha^{-1}$ followed by conoweeding, hand weeding twice. Highest grain and straw yields are recorded in SRI with conoweeding followed by transplanting and hand weeding twice andpyrazosulfuron-ethyl@20 $g.ha^{-1}$.

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