Journal Crop and Weed, 12(2):137-140(2016)

Influence of age of seedling and weed management on weeds and yield of rice in system of rice intensification under temperate conditions of Kashmir

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Received: 04-06-2016; Revised: 15-09-2016; Accepted: 25-09-2016

ABSTRACT

During kharif seasons of 2010 and 2011, field studies were conducted to assess the influence of age of seedling and weed management practices on weeds and yield of rice in System of rice intensification under temperate conditions at Mountain Research Centre for Field Crops, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, (SKUAST-K) Khudwani, Anantnag J & K, (India) on silty clay loam soil, normal in reaction having medium fertility status. Major weed species infesting the field were; Echinocloa crusgali L., Echinocloa colona L., Cyperus iria L., Cyperu sdifformis L., Marsilia quadrifolia L., Potamogeton distinctus., A. Benn., Ammania baccifera L. and Monochoria vaginalis. The results revealed that planting 15 days old seedlings resulted in better crop establishment that produced more number of panicles resulting in higher grain yield with an advantage of 13.2 per cent over planting of 10 days old seedlings. Comparatively higher density and dry weight of weeds was recorded in crop planted with 10 days old seedlings. Weed control through cono-weeding (four times) recorded lower number and dry weight of weeds and proved to be significantly superior in terms of grain yield with a yield advantage of 10.6 per cent over two times cono-weeding.

Keywords: Butachlor, Cono-weeding, Grain yield, SRI, Seedling age, Weed management

Rice (*Oryza sativa* L.) is the world's most important food crop and a primary source of food for more than half of the world's population. In Jammu and Kashmir State, rice the staple food for the majority of the population in general and for Kashmir region in particular and is cultivated on 261.35 thousand hectares with a production of 507 thousand tonnes in the state out of which Kashmir valley alone accounts for 62 per cent of the production with an average productivity of 2.48 tonnes ha^{-1} (Anonymous, 2011). In Kashmir manual transplanting is the most dominant and traditional method of crop establishment which not only consumes more water but also causes the stagnation of water resulting in degradation of land. Water resource limitations, shortage of labour during peak season and escalating labour costs make transplanting more expensive and results in reduction in rice yields and net profits. In view of increasing water scarcity it will be no longer feasible to flood rice field to ensure better crop establishment and control weeds as well. System of rice intensification (SRI) is being promoted as an alternative technology and resource management strategy for rice cultivation that may offer the opportunity to boost rice yields with less external inputs and reduces greenhouse gas emissionto some extent for mitigating the effect of climate change. Studies reveal that water use in SRI and AWD was 46 per cent and 36 per cent lower than in conventional flooded rice system, respectively; whereas their yields were similar or significantly higher (5% for SRI and 8% for AWD), resulting in greater WUE . The SRI is considered as a system rather than a technology as it involves the holistic management to give ideal growing conditions to rice plant besides improving soil health with reduction in input use such as seeds and water (Gujja and Thiyagarajan 2009). Weed infestation in rice crop is a major constraint in enhancing the productivity as the weed flora cause a yield reduction upto 43 per cent (Bhat *et al.*, 2011). The effective control measures at initial stage of crop growth can help in improving the productivity of rice. Age of seedling and weed management practices play an important role under limited water situation in SRI production system. In SRI, planting of young seedlings (10-15 days) is difficult under temperate conditions of Kashmir but possible. Further weeds are incorporated and controlled through cono-weeding in SRI which is very drudgarious. In order to standardize the seeding age and economize the weeding in SRI the study was under taken to assess the effect of age of seedling and weed management practices on weeds and grain yield of rice in SRI.

MATERIALS AND METHODS

Field experiment was conducted to study the effect of age of seedling and weed management practices on weeds and grain yield of rice in SRI at Mountain Research Centre for Field Crops, Sher-e-Kashmir

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University of Agricultural Sciences and Technology of Kashmir, Khudwani, Anantnag, Jammu and Kashmir during *kharif* 2010 and 2011. The soil of experimental field was silty clay loam in texture, neutral in reaction (pH 7.3), low in available nitrogen, medium in available phosphorous and potassium. The treatments consisted of two ages of seedlings (10 and 15 days) and four weed management practices (W_1: two times cono-weeder at 10 and 20DAT, W_2: four times cono-weeder at 10, 20, 30 and 40 DAT, W_3: pre-emergence herbicide butachlor 1.5 kg *a.i* ha^{-1} followed by one hand weeding at 20 DAT and butachlor 1.5 kg *a.i* ha^{-1} followed by one Cono-weeding at 20 DAT). The treatments were replicated thrice in a randomized block design with factorial arrangement. Ten and fifteen days old seedlings of rice cultivar Jhelum were raised on mat nursery and transplanted in first week of June as per treatments at a spacing of 25 x 25 cm during both the seasons of experimentation. Well decomposed farm yard manure @ 10 t ha^{-1} was incorporated in the field uniformly during land preparation. As per package of practices 75 per cent of recommended dose of inorganic fertilizers (90:45:22; kg N:P:K ha^{-1}) was applied to the crop. The entire quantity of phosphorus and potassium and half of nitrogen was applied as basal at the time of transplanting while remaining N was applied in two equal splits at active tillering and panicle initiation stages. Herbicide butachlor 50 EC @ 1.5 kg *a.i.* $ha^{-1}$was sprayed with knapsack sprayer fitted with flat fan nozzle using 300 litres of water ha^{-1}. Weed density and dry weight of weeds were recorded at 60 days after transplanting (DAT) using a quadrat whereas the yield and yield attributes were recorded at maturity. The crop was harvested during last week of September in both the years.

RESULTS AND DISCUSSION

Weed flora

The major and dominating weed flora observed in the experimental field consisted of grasses (*Echinocloa crusgal i*L., *Echinocloa colonum* L.), sedges (*Cyperus iria* L., *Cyperus difformis* L., *Fimbristylis littoralis* Gaudich.) and broad leaf weeds (*Marsilia quadrifolia* L., *Potamogeton distinctus* A. Benn., *Ammania baccifera* L., *Monochoria vaginalis)*. The composition of grasses, sedges and broad leaved weeds averaged over two years was 36.3, 21.3 and 42.4 per cent, respectively.

Effect of age of seedlings on yield and yield attributes

The data (Table 1) revealed that seedling age had no significant influence on yield attributes like number of panicles and panicle weight during 2010. However, planting 15 days old seedlings recorded significantly higher grain yield (10.34%) than 10 days old seedlings in 2010. During 2011, the number of panicles m^{-2} and grain yield differed significantly due to age of seedling. The crop established by planting 15 days old seedlings produced 5.46 per cent number of panicles m^{-2} and 16.05 per cent higher grain yield than 10 days old seedlings. Panicle weight was not affected significantly by the age of seedling during both the years. Higher grain yield in case of transplanting 15 days old seedlings might be attributed to greater root development, more flourishing capacity of the seedlings at the initial stage and higher number of panicles which ultimately improved the grain yield. Similar results have been reported by Ramachandra *et al* (2012). Density and dry weight of weeds was not significantly influenced by the age of seedlings planted at 10 or 15 days old (Table 2). However, lower weed dry weight (22.13 g) was recorded in the plots planted with 15 day old seedlings than 10 day old seedlings (24.29 g). The higher weed dry weight in the crop raised by planting 10 day old seedlings resulted from slightly more number of weeds present in the plot.

Effect of weed management practices on weeds and rice yield

Weed management practices had a significant influence on population and dry weight of weeds (Table 2 and Fig. 1). Four times cono-weeding (10,20,30 and 40 DAT) though *at par* with pre-emergence application of butachlor followed by cono-weeding at 20 DAT recorded significantly lower weed density and dry weight (26.67 and 18.85 g) as against two times cono-weeding (56.66 and 32.28 g). A Positive correlation existed between weed control methods and weed dry weight (Fig. 2). Kumar (2012) from IARI New Delhi also reported that cono-weeding thrice at 15, 30 and 45 DAT caused the highest reduction in the growth of weeds with the highest weed control index of 88.59 per cent and produced significantly higher grain yield of rice over weedy check Mechanical weeder without engine under Iran conditions reduced the dry weight of weeds significantly in rice (Fazlollah *et al.* 2011). Yield and yield attributes of rice were also significantly influenced by weed management practices (Table 1). Maximum grain yield of 7.3 t ha^{-1} (pooled) was recorded in four times cono-weeding which was significantly superior to two times cono-weeding (6.61 t ha^{-1}) thereby exhibiting a yield advantage of 10.6 per cent. This might be due to effective weed control by periodic cono-weeding which in turn enhanced the number of panicles and improved the grain yield. Kumar *et al.* (2009) and Ramachandra *et al.* (2012) have also reported enhancement in grain yield of rice by cono-weedings in SRI.

Table 1 : Yield attributes and yield of rice as influenced by age of seedlings and weed management practices

Treatment	Panicles (No. m^{-2})		Panicle weight (g)		Grain yield (q ha^{-1})			Straw yield (q ha^{-1})	
	2010	2011	2010	2011	2010	2011	Pooled	2010	2011
Age of Seedling									
10 days old	399	366	2.82	2.92	67.12	65.60	66.35	79.84	77.46
15 days old	402	386	2.88	3.02	74.06	76.13	75.02	88.58	89.03
L.S.D. (0.05)	**NS**	**16**	**NS**	**NS**	**4.72**	**5.30**	**4.35**	**5.12**	**6.14**
Weed Management Practices									
Two times cono-weeder	395	368	2.82	2.88	67.52	64.84	66.17	80.65	81.50
Four times cono-weeder	407	381	2.97	3.03	73.00	73.85	73.43	86.14	85.28
Butachlor fb hand weeding at 20 DAT	400	373	2.75	3.00	71.24	72.75	71.98	84.02	81.66
Butachlor fb Cono-weeding at 20 DAT	402	381	2.92	2.97	72.64	72.02	72.33	86.38	84.54
L.S.D. (0.05)	**NS**	**12**	**NS**	**NS**	**3.64**	**3.22**	**3.46**	**4.68**	**5.78**

Table 2 :Effect of age of seedling and weed management practices on weed density, weed dry weight, and economics of transplanted rice (Pooled over 2 years)

Treatment	Weed density (No.m^{-2} 60 DAT)	Weed dry weight (gm^{-2})	Cost of cultivation (x10^3Rs ha^{-1})	Gross returns (x10^3 Rs ha^{-1})	Net returns (x10^3 Rs ha^{-1})	B:C ratio
Age of Seedling						
10 days	33.00	24.29	30.35	78.17	47.82	1.58
15 days	31.50	22.13	30.35	87.27	56.92	1.88
L.S.D. (0.05)	NS	NS		-		
Weed Management Practices						
Two times cono-weeder	56.66	32.28	33.45	77.98	44.53	1.33
Four times cono-weeder	26.67	18.85	36.15	85.69	49.53	1.37
Butachlor fb hand weeding at 20 DAT	23.67	21.50	36.95	84.08	47.13	1.28
Butachlor fb Cono- weeding at 20 DAT	22.00	18.14	36.05	84.45	48.40	1.34
L.S.D. (0.05)	**4.78**	**7.03**	**-**	**-**	**-**	**-**

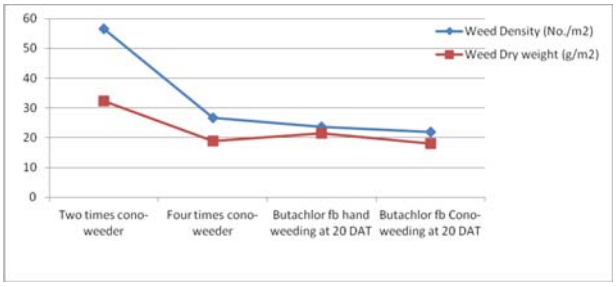

Fig 1. : Effect of weed control methods on density and dry weight of weeds

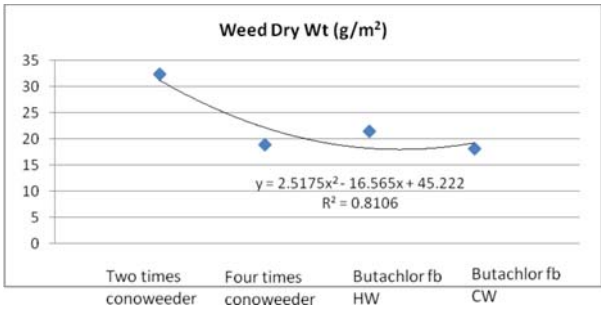

Fig 2 : Correlation between weed control methods and dry weight of weeds

Economics

Planting 15 day old seedlings in SRI method of rice cultivation recorded higher net returns (Rs. 56920) and B: C ratio (1.88) than planting 10 days old seedlings (Table 2). Among weed management practices cono weeding four times provided higher net returns (Rs. 49530) and B:C ratio (1.37) as compared to pre-emergence herbicide (butachlor) application followed by hand weeding.

From the studies it can be concluded that four cono-weedings at an interval of 10 days from transplanting provide satisfactory control of weeds in rice under SRI and improve the grain yield as compared to pre-emergence application of butachlor.

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