Effect of Brown Manuring and Herbicide Application on Weed Parameters on Aerobic Rice Under Varying Planting Geometry

ABSTRACT

A Field Experimentwas conducted at Main Rice Research Centre, Navsari Agricultural University, Navsari during *kharif* 2021. The experiment was carried out in randomized block design with factorial concept with three replication. The results revealed thatdensity of grasses, sedges, broad-leaved weeds and thus total weed density were significantly higher in 40 cm line sowing at 20 DAS and 40 DAS. Weed dryweight at 60 DAS and at harvest was also significantly higher with 40 cm line sowing. Handweedingtwiceat20and40DAS recorded no weed at 20 DAS and at 40 DAS and was closely followed by Pendimethalin750ga.i.ha^{-1}(PE)+Bispyribacsodium40gha^{-1}at30 DAS. Considerably lower weed dry weight at 60 DAS andat harvest was recordedwithHandweedingtwiceat20and40DAS whichwasat par with Pendimethalin750ga.i.ha^{-1}(PE)+Bispyribacsodium40gha^{-1}at30 DAS. Numerically higher weed control efficiency at 60 DAS and atharvest and lowerweed indexwasalso recordedbyHandweedingtwiceat20and40DAS followed byPendimethalin750ga.i.ha^{-1}(PE)+Bispyribacsodium40gha^{-1}at30 DAS. Weed smothering efficiency was found to be higher with Pendimethalin750ga.i.ha^{-1}(PE)+BrownManuring at 60 DAS and at harvest.

Keywords*: Herbicide, Brown manuring, Aerobic rice, Crop geometry, Weed parameters*

Introduction

Cereals are the most important part of a human's diet throughout the worldand have the ability to meet the food demand of an increasing population. India has the largest area under rice cultivation in the world. Aerobic rice is grown in well-drained, non-puddled and non- saturated soil and hence, weed menace is more compared to flooded rice. Direct seeding changes the type and relative abundance of weed flora. The weed flora found in direct seeded rice are *Echinochloacrusgalli ,Echinochloacolona , Digitariasanguinalis, Eleusine indica , Cyperusiria , Eclipta alba, etc*. (MahajanandTimsina, 2011). Weeds having fast nutrient and moisture absorption ability and higher reproduction capacity, grows faster than crop and smoothers the crop, resulting inpoor growth and reduced yield of rice. Yield loss due to weed flora varies from40 to 100 per cent depending upon weed flora, weed intensity and crop-weed competition time (Choubey *et al*., 2001).

In aerobic rice growers practice two to three mechanical weeding which controls weed effectively and are environment friendly too, but this is time consuming, labour intensive, tedious and expensive. Therefore, a proper alternative is chemical herbicideswhich have rapid effect on weeds and are cheaper and easier to use than traditional method ofhand weeding (Mian and Mamun, 1969). Herbicides have contributed substantiallytothe spectacular decrease in weed biomass and weed dry weight. However, application of inorganic herbicides alone in large quantities over a longer period has posed someenvironmentalproblems [6,7]. Frequent use ofherbicides develops resistance in weed flora and shift in weed population. So,there is need for integrated environment friendly approach which can supplement the use of herbicides in long run [8-10]. Brown manuring reduces

weed population because of its faster growth rate thanweeds and maintains ground cover to have higher dry matter production of crops before weeds set viable seeds.

MaterialsandMethods

A field experiment was conducted during the *kharif* season of the year 2021 at Main Rice Research Centre, Navsari AgriculturalUniversity, Navsari, Gujarat. The experimental site was medium in organic carbon, available nitrogen and phosphorus and very high in available potassium. This experiment was laid out in randomized block design with twelve treatment combinations replicated thrice using the rice variety "GNR-8 (Aarti)". The two factors under investigation comprised of(Factor 1) spacing level: S_1 – 30 cm line sowing, S_2 – 40 cm line sowing and (Factor 2) weed management treatments: W_1 - Brownmanuringat 30 days, W_2 -Pendimethalin 750 g a.i./ha (PE) + Brown manuring, W_3 - Pyrazosulfuron ethyl 25 g a.i./ha (PE) Brown manuring, W_4 - Pendimethalin 750 g a.i./ha (PE) + Bispyribac sodium 40 g a.i./ha at 30 DAS, W_5 - Hand weeding twice at 20 and 40 DAS and W_6 - Weed check. Therecommendeddoseoffertilizer @100-30-00 NPKkg ha^{-1}wereapplied to the crop. The field was levelled and dhaincha seeds @ 20 kg ha^{-1} were broadcasted as per treatments. Thereafter, the seeds of rice cv. GNR-8 @ 50 kg ha^{-1} was directly sown in rows with the row spacing of 30 cm and 40 cm according to treatment. Weed management was carried out at required time as per treatment. The required quantities of all three herbicides were worked out according to treatmentsanddissolved in500 l ha^{-1} and600 l ha^{-1} waterforpreandpost emergence herbicides, respectively. The prepared solutions were sprayed separately as per treatment in respective plots. For brown manuring, dhaincha were knocked down at 30 DAS with application of 2,4-D sodium salt @ 1.25 l ha^{-1}.Hand weeding was done with help of *khurpi*as per treatment.

RESULTSANDDISCUSSION

Weed Count(m^{-2})at20DAS and 40DAS

The results on weed density of grasses, broad-leaved weeds and sedges along withtotalweed density in experimentalplots during studywith different treatments at 20DASand40DAS ispresented inFig.1. Between the two spacing level, the density of grasses, sedges, broad-leaved weeds and thus total weed density were significantly higher in 40 cm line sowing as compared to 30 cm line sowing at 20 DAS and 40 DAS. This was because narrow spacing provideslesser space for weed growth and thus better crop-weed competition as compared to wider spacing. These findings are in accordance with Chauhan and Jhonson (2010) and Sunyob*et al*. (2012). Among the weed management practices, no weeds were observed with handweedingtwiceat20DASand40DAS.Significantlylowergrassyweeds,sedges and total weeds were found with pendimethalin 750 g a.i. ha^{-1} + brown manuring (W_2) and pyrazosulfuron ethyl 25 g a.i. ha^{-1}(PE) + brown manuring (W_3). Weed check treatment recorded significantly higher density of grasses, broad-leaved weeds, sedges and total weeds. At 40 DAS, again no weed count was observed with treatment of two hand weeding at 20 DAS and 40 DAS. Next to this lower density ofgrasses, sedges and total weeds were recorded with treatment W_4 (pendimethalin 750 g a.i. ha^{-1} + bispyribac sodium 40 g a.i. ha^{-1} at 30 DAS). In terms of dicot control, W_4 (pendimethalin 750 g a.i. ha^{-1} + bispyribac

sodium 40 g a.i. ha^{-1} at 30 DAS), W_2 (pendimethalin 750 g a.i. ha^{-1} (PE) + brown manuring), W_3 (pyrazosulfuron ethyl 25 g a.i. ha^{-1} (PE) + brown manuring) and W_1 (brown manuring at 30 days) treatments were found equally effective. This finding has also been supported by Maity and Mukherjee (2011).

Brown manuring alone reduced grasses by 39.55 per cent and 39.54 per cent, sedgesby 25percentand27.36percent,broad-leavedweedsby37.14percentand 59.21 per cent andtotalweed densityby37.48 per cent and 46.35 per cent at 20 DAS and 40 DAS, respectively in comparison to weedy check. Srawe*t al.* (2017) and Nawaj *et al.* (2017) also reported similar results. Integration of brown manuring and pre-emergence herbicides controlled all types of weed to a considerable level due to the synergistic effect of herbicidal effect coupled with smothering action of brown manuring. The interactioneffect betweenweed management treatmentsand spacing level was non -significant.

Weed DryWeight(gm^{-2})at60DASandat Harvest

Theresults pertaining to weeddrymatteraccumulationat 60DASand harvest is graphically depicted in Fig. 1. Between the two spacing level, higher total dry matter production of weed wasunder wider spacing *i.e.,* 40cmlinesowingas comparedto closer spacing *i.e.,* 30 cmline sowing at bothcrop growthstages. This finding is in accordance with Sunyobe*t al.* (2012) and Kaushik *et al.* (2020). Two hand weeding at 20 DAS and 40 DAS *i.e.,* weed free treatment recorded the minimum (5.87 g m^{-2} and 10.10 g m^{-2} at 60 DAS and at harvest, respectively) dry matter. Among herbicides, pendimethalin 750 g a.i. (PE) + bispyribac sodium 40 g a.i. at 30 DAS recorded minimum dry matter followed by pendimethalin 750 g a.i. ha^{-1} (PE) +brown manuring and pyrazosulfuron ethyl 25 g a.i. ha^{-1} (PE)+ brown manuring. This was due to selective control of weeds by herbicides. Similar results were also found by Walia*et al.* (2009) and Pavithra *et al.*(2021). Brown manuring alone reduced weed dry matter by 63.41 per cent and 61.10 per cent at 60 DAS and at harvest, respectively as compared to weedy check. The reduction in weed dry matter showed successful effect of brown manuring in weed smothering. Almost similar finding was observed by Nawaj *et al*. (2017). Interaction effect of row spacing and weed management practices was foundto be non-significant**.**

WeedControlEfficiency (%)

Theresultspertainingto weedcontrolefficiencyrecordedat60DASandat harvest with different rowspacingandweed management practicesarepresentedinFig. 1. Hand weeding twice at 20 DAS and 40 DAS at both the row spacing achieved higher weed control efficiency *i.e.,* 85.11 per cent and 78.83 per cent at 60 DAS and at harvest, respectively. This was followed by pre-emergence application of pendimethalin *fb* bispyribac sodiumat 30 DAS. It might be dueto effective controlof weed by hand weeding at critical crop-weed competition period. Also, integration of pendimethalin with bispyribac sodium effectively controlled distinct types of weed flora in broad spectrum. Patel *et al.* (2018) found similar results. Plot treated with brown manuring only, recorded around 60 to 64 per cent WCE at 60 DAS and at harvest. Integration of brown manuring with pre- emergenceherbicide increased WCE up to 75 to 78 per cent and 71 to 73 per centat 60DASandat harvest, respectively. This maybe probablydueto greaterreductionof grasses, sedges and some BLWs by restricting earlier

germination by PE herbicideand *Sesbania* canopy and later weed flush regrowth suppression by brown manuring. Thus, integration of brown manuring with herbicides provided better weed control. Similar results were also observed by Kumari *et al.* (2020).

WeedIndex (%)

The results pertaining to weed indexas influenced by different weed management practices under varying planting geometry are presented in Fig.1. The results on weed index as affected by weed management treatments revealed that hand weeding twice at 20 DAS and 40 DAS *i.e.* weed free treatment recorded lowest weed index as compared to other treatments because of significantly higher yield production. Minimum weed index of 1.89 per cent was recorded withapplication of pendimethalin 750 g a.i. ha^{-1}*fb* bispyribac sodium 40 g a.i. ha^{-1} at 30 DAS which reflected its selectivity and higher efficacy in weed control and thus marginal yield reduction, whereas poor weed indices (59.98 %) was reported with weed check due to highest weed infestation and poor yield highlighting the significance of weed management in aerobic rice. Plot treated with pre-emergence herbicides, pendimethalin @ 750 g a.i. ha^{-1} and pyrazosulfuron ethyl @ 25 g a.i. ha^{-1} alongwithbrownmanuringrecordedweedindexgreaterthanpendimethalin750g a.i. ha^{-1}*fb* bispyribac sodium 40 g a.i. ha^{-1} at 30 DAS, but less than plot treated with brown manuring only. Plot treated with brown manuring only secured nearly half valueofweedindexthanweedcheck.

WeedSmotheringEfficiency(%)

Weed smothering index at 60 DAS and at harvest was computed and concerned data is presented in Fig. 1. It is the ratio of difference between averageweed dryweightsofweeds in sole crop and averageweed dry weight in intercropping situation to that of average weed dry weight of sole crop. Since in this experiment sole crop and weed check is same, therefore WCE(%) and weed smothering efficiency of all three brown manuring plots is same. Extensive canopyof brown manuring crop precluded solar radiation penetration up to the weeds and thus smothered them.

Conclusion

It can be concluded that aerobic ricecanattainmaximumyieldwithhandweedingtwiceat20DASand40DASby managing the weeds efficiently. But on account of cost effectiveness, pendimethalin 750 g a.i.ha^{-1} (PE) + bispyribac sodium 40 g a.i. ha^{-1} at 30DAS was found most economical.

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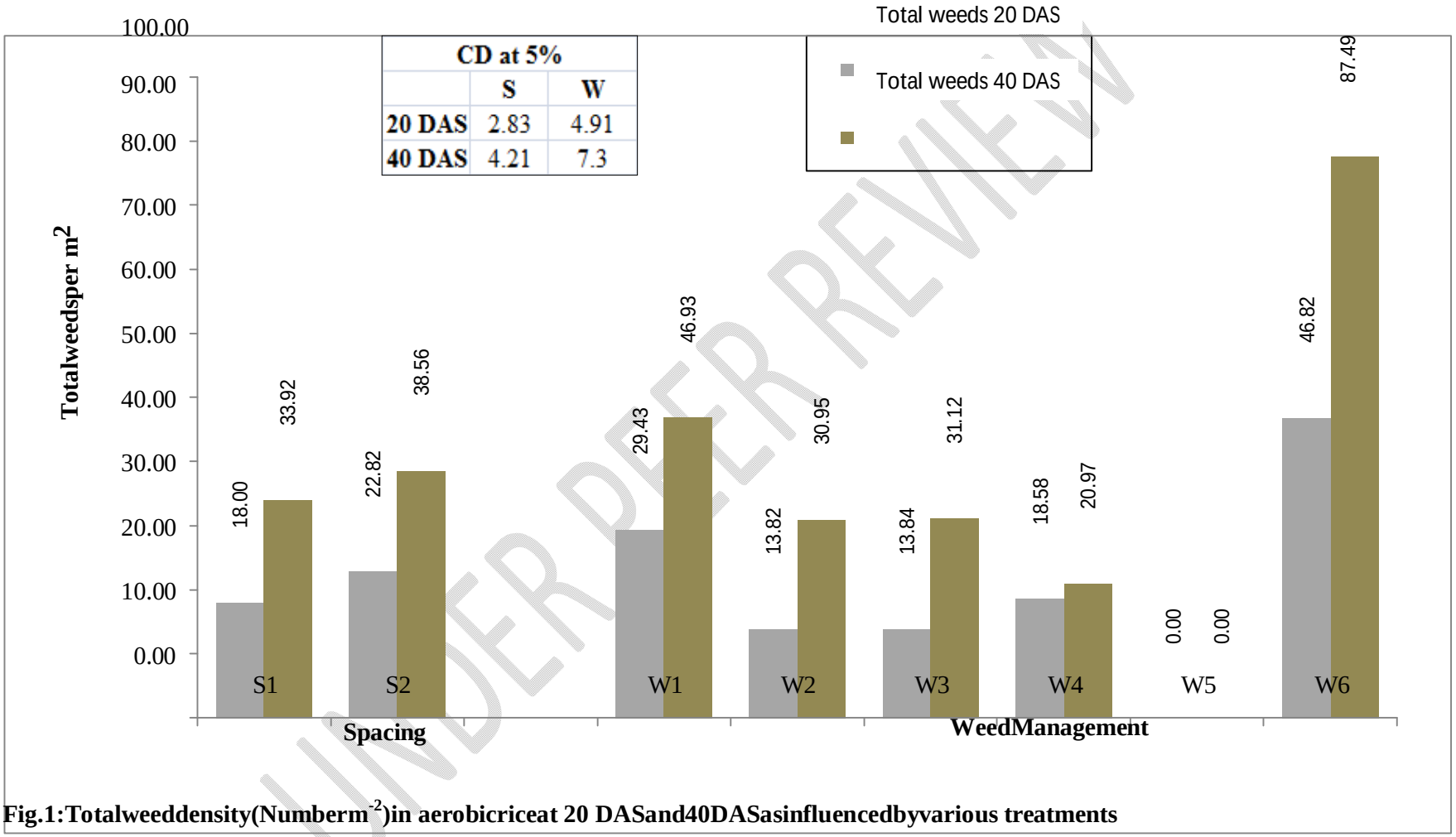

Fig.1:Totalweeddensity(Numberm^{-2})in aerobicriceat 20 DASand40DASasinfluencedbyvarious treatments