Weed Management in Transplanted Rice: A Review

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ABSTRACT

Rice is an important food crop extensively grown in India. Several factors are responsible for reducing the yield of transplant rice. However, weed infestation is the major threat to productivity of transplanted rice. Weeds by the virtue of their high adaptability and faster growth dominate the crop habitat and reduce the yield potential of the crop. These weeds could be controlled through manual and chemical methods. Manual method is though very common but cost intensive. Herbicides when applied alone is although economical but may have limitation of resistance development shift in weed flora etc. Weeds are one of the major biological threats to higher rice productivity worldwide. Various cultural, biological, physical and chemical practices affect the composition and intensity of weeds in rice fields. Generally, weeds can be controlled through herbicides; nevertheless, chemical weed control is not a sustainable option on a long term. Various agronomic practices such as the use of tolerant cultivars may reduce the weed pressure in rice. Integrated approaches for weed management, emphasizing on the combination of management practices and scientific knowledge, may reduce the economic costs and improve weed control owing to the complexity of the weed community. Herbicides combination of weed control significantly reduced the weed population and their dry weight effectively over weedy check. Among the herbicide application Bispyribac +Almix 20+4 g a.i. ha-1 25 DAT was controlled the narrow and broad leaves weeds very effectively and recorded higher value of weed control efficiency and yield of rice. Therefore, presently there is a need to use high efficacy herbicides in combination coupled with broad spectrum nature to control the complex weed flora in transplanted rice. Also, the combinations of herbicides increase the range of weed control, save time and reduce the cost of cultivation.

Keywords: *Rice, chemical herbicide, weed control efficiency, weed competition index*

INTRODUCTION

Introduction Rice is a major crop in the world, it feeds one third of the world population to whom it supplies almost two thirds of the food requirements. From an area of 42.13 million ha, India is producing about 40% of the world rice production. The diverse weed flora under transplanted conditions (grasses, sedges and broad-leaved weeds) can cause yield reduction up to 76% (Singh et al., 2004). In order to realize maximum benefit of applied monetary inputs, two to three hand weedings (HW) were most effective against all types of weeds in this crop (Halder and Patra, 2007). However, continuous rains during cropping season, scarcity and high wages of labour during weeding peaks particularly at early crop-weed competition make this operation difficult and uneconomic.

The weed flora under transplanted condition is very much diverse and consists of grasses, sedges and broad-leaf weeds causing yield reduction of rice crop up to 76%. Recently, Penoxsulam is emerged as a new acetolactate synthase (ALS) inhibitor herbicide for post-emergence control of annual grasses, sedges and broadleaf weeds in rice culture (Jabusch and Tjeerdema, 2005). Bispyribac-sodium, a pyrimidinyl carboxy herbicide, is also effective to control many annual and perennial grasses, sedges and broad-leaved weeds in rice fields (Yun et al., 2005). Bensulfuron-methyl was studied for controlling sedges and non-grassy weeds in transplanted rice and Tank-mix application of Bensulfuron-methyl + Pretilachlor (50+500 g/ha) was found to be the most effective herbicide treatments with weed control efficiency 95% and produced 5.72 tonnes/ha yield (Sanjoy Saha, 2009). Therefore, farmers need alternate weed management methodology and organic safer herbicides are one of the better substitutions of costly hand weeding. The goal of herbicide use is to kill or stunt weed infestation allowing the rice

to grow and gain a competitive advantage. The chemical weed control method is becoming popular among the farmers because it is the most efficient means of reducing weeds competition with minimum labor cost.

Losses due to weed

Weed competes with the crop plants in the field for nutrients, moisture and sunlight. The nature and severity of weed competition depend on (a) types of weed species, (b) intensity of infestation, (c) duration of weed infestation, (d) competing ability of the crop plants and (e) soil-climate conditions which affect the crop and weed growth. Reduction in grain yield is directly correlated with the severity of weed competition. The prominent weed flora appearing in the rice field at different stages of crop growth under varied environmental situation differed because different species of weed flora required different agro-ecosystem. Grassy weeds were heavy competitors with rice crop and were followed by sedges and broad leaved weeds (Umapathy and Sivakumar, 2000). Kumar et al. (2010) reported that the reduction in grain yield of rice due to uncontrolled weeds in weedy plot was 70.4 % during 2006 and 67.4 percent during 2007 as compared to weed control treatments. Puniya et al. (2007) noticed that the highest loss of nutrients were occurred in unweeded (42.07, 10.00 and 21.80 kg NPK/ha) due to more density and dry weight of weeds in rice.

Relative density of weeds

The dominant weed species associated with transplanted rice were sedges and shared the highest percentage of total weed density (73.3 %) (Singh et al., 2005). Saha (2006) observed that predominant weed species consisted of 14.3 % grasses, 46.2 % sedges and 39.5 % broad leaved weeds at 30 DAT in unweeded check. The major weed density observed were 16.5 % grasses, 51.5 % sedges and 32 % broad leaved weeds in transplanted rice of Andhra (Kiran et al., 2010). Patra et al. (2011) noted that 27.2 % grasses, 36.8 % sedges and 36 % broad leaved weeds in rice. Unweeded check registered more *Cyperus rotundus* in sodic soil environment of Tiruchirappalli (Revathi et al., 2017). In transplanted rice grasses (65.4 %) was the dominant weed, followed by sedges (30.1 %) and BLW (4.5 %) at 60 DAT in unweeded control (Manisankar, 2019b).

Methods of weed control in rice field:

Weed control methods are grouped into cultural, manual, mechanical, chemical and biological methods. Each of them has their own advantage and disadvantage and single method is rarely found effective so, summarized reviews are given below particularly for manual weeding and chemical methods of weed control in transplanted rice.

Cultural methods

Several cultural practices like tillage, planting, fertilizer application, irrigation etc., are employed for creating favorable condition for the crop. These practices is used properly, help in controlling weeds. Cultural methods, alone cannot control weeds, but help in reducing weed population. Puddling and submerged condition under transplanting reduced weed germination. The closely spaced crop effectively smothered the weeds growing under crop canopy by not providing sufficient space for weed growth complemented by restricting sunlight from penetrating downwards (Brar and Walia, 2001). Prasad et al. (2001) stated that transplanting recorded the lowest weed population (63.5 m^{-2}) and weed dry weight (24.1 gm^{-2}) which was followed by sowing of sprouted seeds in puddle condition and dry drilling seeds.

Chander and Pandey (2001) observed that hand weeding increased grain as well as straw yields compared to herbicides and weedy check because of frequent elimination of weeds that resulted in the reduced weed competition. Dutta et al. (2005) reported that hand weeding twice at 21 and 42 DAS recorded the highest weed control efficiency and increased grain and straw yield of rice crop. Pal et al. (2009) opined that hand weeding on 20 and 40 DAT recorded highest grain yield of 5.08 t ha^{-1} in Gangetic alluvial soil because it gave very little scope to weeds to flourish and to compete with the crop preferably at the critical stage of crop weed competition.

Manual weeding

The earliest ways of weed control in rice were cultural methods. In spite of labor intensive hand weeding is still most common direct weed control method in rice in India using bare hands and hand tools. These practices are only effective when weeds attain height to provide better grip for uprooting Bhan et al., (1980). Rekha et al., (2002) reported that twice hand weeding resulted in lower weed density as compared to herbicides and untreated control. Jayadeva et al., (2009) from Karnataka observed that Hand weeding twice (20 and 24 DAT) recorded lower weed dry weight and higher mean grain and straw yield in rice.

Mechanical or Physical weeding

This methods includes the use of hand tools, implements and machinery operated either with the help of man power or machine power for control of weeds. These are costly and time consuming methods. However, these methods cause minimum damage to the environment. Rotary weeder was effective in controlling the weeds present in inter row space, but failed to control the weeds in intra row space or those in the vicinity of the crop. Cono-weeding alone was found to contribute 17.43 per cent for grain yield when the average grain yield under the cono-weeding treatments 3376 kg ha^{-1} was compared against the average grain yield under hand weeding treatments 2875 kg ha^{-1} (Sreedevi, 2006). Mrunalini and Ganesh, (2008) opined that the implements like cono-weeder that helped to save labour, time and reduced man days required for weeding from 30 to 10 as they become more experienced in handling the cono-weeder implement.

Chemical weed control

In general, cultural and mechanical methods of weed control are time consuming, cumbersome and laborious apart from being less effective because of chance of escape and regeneration of weeds from roots or rhizome that are left behind. The morphological similarity between the crop and certain grassy weeds makes hand weeding difficult. The use of herbicides therefore, appears to be the only alternative. In present context it is most preferable and farmer can easily go for it because day by day increases labour problems. Under puddle sown rice culture, chemical method of weed control is the efficient method for controlling grasses, sedges and broadleaved weeds, and reducing the labour cost and achieving higher grain yield. Kumar et al. (2008) conducted the field experiment at crop research centre, GBPUAT; (Pantnagar) during Kharif season of 2006 and reported that Anilophos @ 0.6 kg a.i. ha^{-1} applied at one DAS integrated with one hand weeding at 45 DAS proved significantly superior over all other treatments in reducing weed population and obtaining maximum grain yield. Maximum weed control efficiency (86.93%). Singh and Singh (2010) reported that application of pretilachlor @ 0.75 kg a.i. ha^{-1} as pre-emergence followed by 2, 4-D @ 0.50 kg a.i. ha^{-1} as post emergence proved to be most effective in minimizing the density of weeds and their dry weight, it enhances the weed control efficiency (84.24%); grain yield (4.73 t ha^{-1}), NPK uptake by crop, net return (Rs. 26,610) and B: C ratio (1.92). Angiras and Kumar, (2005) found that application of pyrazosulfuron ethyl @ 20 or 25 g ha^{-1} at 3 or 10 DAT significantly reduced the weed density and weed dry matter in transplanted rice during kharif season

Halder and Patra (2007) also found that due to weed infestation about 50% yield reduction occur in transplanted rice. Weeds caused 30 to 32% losses in grain yield in weedy check as compared to weed free treatment (Singh et al., 2007). Rodenburg and Johnson, (2009) observed that rice yield losses due to uncontrolled weed growth ranges from 28 to74% and 28 to 89% in transplanted lowland and direct-seeded lowland rice, respectively. Hossain et al. (2010) from Ranchi reported that the weed population as well as dry matter was reduced in transplanted rice with higher weed control efficiency resulting in higher grain yield.

Yadav et al. (2009) found that bispyribac at 25 g ha^{-1} applied at 15-25 DAT could be a suitable herbicide for complex weed flora in transplanted rice. The highest weed control efficiency, grain yield and benefit : cost ratio were recorded with sequential application of oxadiargyl 75 g ha^{-1} and bispyribac-sodium 30 g ha^{-1} which were at par with HW twice at 20 and 40 DAT in transplanted rice (Kiran et al., 2010). Kumar et al. (2010) revealed that among the weed management practices, mechanical hoeing using cono weeder (twice at 15 and 30 DAT) reduced the total weed population and dry weight significantly at all the crop growth stages than weedy check but was at par with fenoxaprop-p-ethyl (0.06 kg ha^{-1} , 20 DAT) + 1 H.W (30 DAT) followed by metasulfuron methyl + chlorimuron ethyl (0.004 kg ha^{-1} , 20 DAT) + 1 H.W (30 DAT), fenoxaprop-p-ethyl (0.06 kg ha^{-1} , 20 DAT) and metasulfuron methyl + chlorimuron ethyl (0.004 kg ha^{-1} , 20 DAT) and also recorded maximum grain yield (4256 and 4393 kg ha^{-1}), respectively over other treatments.

Nutrient Removal by Weeds

Weeds usually grow faster than the crop plants and absorb added nutrient more rapidly and in larger quantities than by crops (De Datta and Baltazar, 1996) and thus deprive the supply of nutrients in time to the crop plants. Weeds removed nutrients (N, P and K) eight times higher under direct seeded rice compared to that of puddled transplanting (Singh et al., 2002). Sudhalakshmi et al. (2005) reported that nutrient uptake by weeds was 30 kg N, 10 kg P and 17 kg K per hectare in transplanted rice in clay loam soil of Coimbatore. Puniya et al. (2007) noticed that the highest loss of nutrients (N 42.07, P 10.00 and K 21.80 $kgha^{-1}$) occurred with unweeded control due to more density and dry weight of weeds in transplanted rice.

CONCLUSIONS

Weeds pose a major problem in rice production as they not only compete with crop but also hinder the quality of rice produce. Any delay in weeding will lead to increased weed biomass as a result there is drastic reduction in total yield of the crop. Therefore, to avert the economic losses a broad spectrum weed control should be affective during the life cycle especially during the critical stages of rice crop. Effective control of weeds in rice could be achieved with the help of cultural methods, manual weeding, mechanical weeding and chemical weed control. Chemical weed control is getting importance in areas, where labour is scarce and costly. Some of the herbicides either alone or their combinations at lower dose have been proved economically viable alternative to hand weeding in management of weeds in rice field. These uses of all suitable management technique are utilized in such a compatible way as to reduce weed population below economic threshold levels without deteriorating environment quality. Weeds are one of the major constraints to the successful cultivation of rice. Therefore, appropriate and economical weed management technology is to be developed for the sustainable rice cultivation. The adoption of any one method of weed control, whether cultural, mechanical, or chemical, may not provide effective weed control in rice. Therefore, an integrated strategy of weed management is needed for the sustainable rice production.

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