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Weed population dynamics in transplanted rice

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Abstract
A field experiment conducted during *kharif*, 2014 at college farm, Collage of Agriculture, Rajendranagar, Hyderabad, Telangana state comprised of fourteen weed management practices T_1: pretilachlor @ 625 g a.i. ha^{-1} as pre emergence (PE) at 3 days after transplanting (DAT), T_2: pyrazosulfuron ethyl @ 20 g a.i. ha^{-1} 3 DAT, T_3: pretilachlor 6% + bensulfuron methyl 0.6% @ 10 kg granules ha^{-1} as PE at 3 DAT, T_4: pyrazosulfuron ethyl @ 20 g a.i. ha^{-1} at 3 DAT followed by (fb) manual weeding at 25 DAT, T_5: penoxsulam @ 22.5 g a.i. ha^{-1} as early PoE at 12 DAT, T_6: cyhalofop-p-butyl @ 100 g a.i. ha^{-1} as early post emergence (PoE) 15 DAT T_7: bispyribac sodium @ 25 g a.i. ha^{-1} as PoE 25 DAT, T_8: azimsulfuron @ 35 g a.i. ha^{-1} as PoE at 25 DAT, T_9: bispyribac sodium @ 25 g a.i. ha^{-1}+ ethoxy sulfuron 18.75 g a.i. ha^{-1} as PoE at 25 DAT, T_{10}: bispyribac sodium @ 20 g a.i. ha^{-1}+ metsulfuron methyl + chlorimuron ethyl @ 4 g a.i. ha^{-1} as PoE at 25 DAT, T_{11}: pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT fb ethoxy sulfuron @ 18.75 g a.i. ha^{-1} as PoE at 25 DAT, T_{12}: pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT fb metsulfuron methyl + chlorimuron ethyl @ 4 g a.i.ha^{-1} as PoE at 25 DAT, T_{13}: hand weeding twice at 25 and 45 DAT and T_{14}: weedy check in randomized complete block design, replicated thrice. Based on importance value index (IVI) *Bacopa monnieri* among broad leaf weeds, *Echinochloa crusgalli* among grasses and *Fimbristylis dichotoma* among sedges were ecologically more dominant weed species.

Keywords: Weeds, transplanted rice, weed dynamics, herbicide technology

Introduction
To safeguard and sustain the food security in India, it is important to increase the productivity of rice under limited resources. So the technologies followed in India need to be constantly updated to meet these challenges, which also demands considerable amount of external inputs, such as fertilizers, pesticides and management technologies. Rice crop suffers from various biotic and abiotic production constraints. Weed competition is one of the major yield limiting factors among biotic constraints in rice. Herbicide technology offers an alternative method of selective and economical control of weeds right from the beginning, giving crop an advantage of good start and competitive superiority. The development of herbicides for weed control was a fascinating success story during the last decade, generally, most herbicides are effective for selective weed control and a single herbicide cannot control all weeds of the community (Corbelt *et al*., 2004) [1]. Combination products consisting of two or more herbicides have greater activity on diverse weed flora due to differential mode of action and have become popular in recent years. Hence the focus at present is on new molecules with low dose and high efficacy in the field conditions.

Materials and methods
The investigation was carried out during *kharif* at college farm, Professor Jayashankar State Agricultural university, Rajendranagar, Hyderabad, situated at an altitude of 542.3 m above MSL at 17º19' N latitude and 78º23' E longitude. Details of the herbicides used in the study are given below.

Weed Flora
Weed flora of the experimental treatments was identified at 30 DAT, 60 DAT, 90 DAT and at harvest.

Relative density (RD_c %)
Relative density used to express the dominance of particular species over other in terms of numbers in mixture of weed population and expressed in percentage.

Relative density was computed using the equation suggested by Philips (1959) [5].

$$RDc = \frac{\text{Number of individual speies in quadrate}}{\text{Total number of species in quadrate}} \times 100$$

Relative frequency (RF %)

It is the ratio between the absolute frequency for a species and total of the absolute frequencies for all species. Relative frequency was computed using the equation suggested by Philips (1959) [5].

$$RF = \frac{\text{Absolute frequency of a species}}{\text{Sum absolute frequency of all species}} \times 100$$

Absolute

$$\text{frequency of a species} = \frac{\text{No. of quadrates of occurance of a species}}{\text{Total no. of quadrates}} \times 100$$

Relative dominance (RD$_o$ %)

Relative dominance is used to express dominance of particular species over other in a mixture of weed population and expressed in percentage. It was computed using the equation suggested by Muller-Dombois & Ellenberg (1974) [3]

$$RDo = \frac{\text{Dominance of a species}}{\text{Sum of dominace of all species}} \times 100$$

Where,

$$\text{Dominance of a species} = \frac{\text{Absolute density of a species}}{\text{No. of quadrates in which the species occured}} \times 100$$

Importance value Index (IVI)

It is used to express the dominance and ecological success of any species in a single value only. Importance value Index was computed using the equation suggested by Muller – Dombois & Ellenberg (1974) [3]

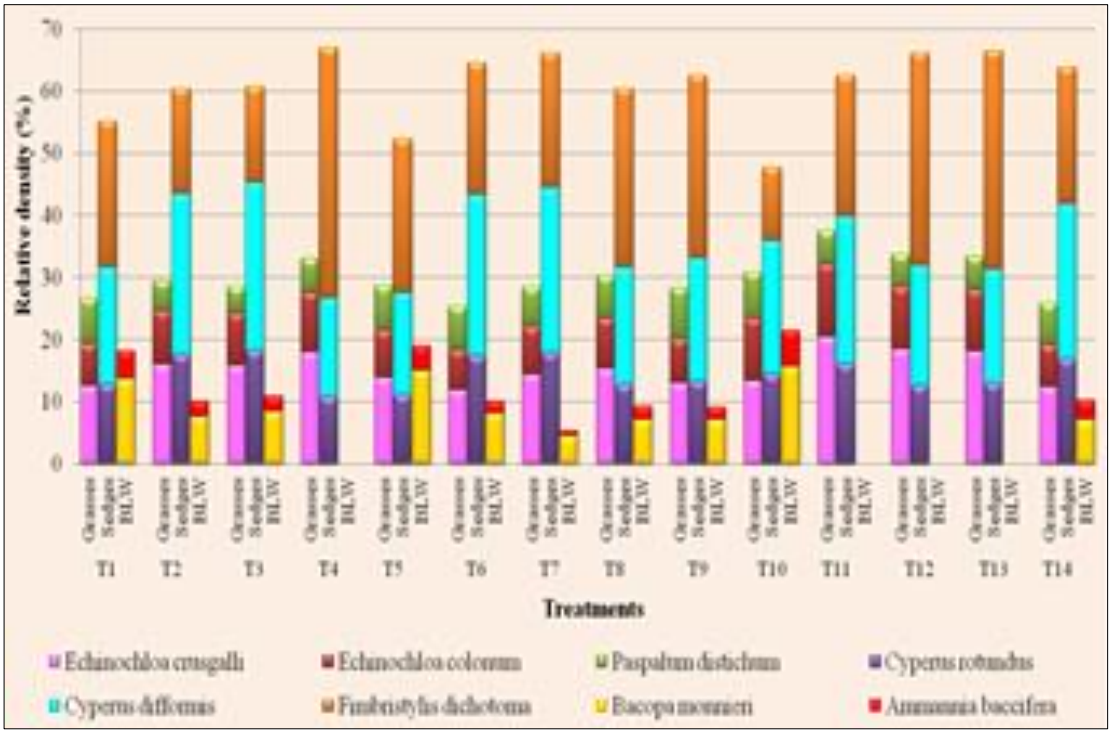
$$IVI = \frac{\text{Relative density + Relative frequency + Relative dominance}}{3}$$

Results and Discussion

Relative weed density (%)

At 30 DAT relative density of sedge weeds consisting of *Fimbristylis dichotoma*, *Cyperus rotundus* and *Cyperus difformis* were more in all the treatments compared to grasses and broad leaved weeds. Relative density of grass weed density was higher in the treatments T_{11} (pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT followed by ethoxysulfuron @ 18.75 g a.i. ha^{-1} as PoE at 25 DAT). Among the grasses relative density of *Echinochloa crusgalli* was more. The broad leaved species observed were *Ammannia baccifera* and *Bacopa monnieri*. There was no broad leaved weed species in treatments T_4 (pyrazosulfuron ethyl @ 20 g a.i. ha^{-1} as PE at 3 DAT followed by manual weeding at 25 DAT), T_{11} (pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT followed by ethoxysulfuron @ 18.75 g a.i. ha^{-1} as PoE at 25 DAT), T_{12} (pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT followed by metsulfuron methyl + chlorimuron ethyl @ 4 g a.i. ha^{-1} as PoE at 25 DAT) and T_{13} (hand weeding twice at 25 and 45 DAT), while the mean relative density of broad leaf weeds was more in T_{10} (bispyribac sodium @ 20 g a.i. ha^{-1} + metsulfuron methyl + chlorimuron ethyl @ 4 g a.i. ha^{-1} as PoE at 25 DAT)

At 60 DAT increase in relative density of broad leaf weeds and grasses was also observed in addition to sedges present at 30 DAT. Relative density of grasses was increased in all treatments except T_3 (pretilachlor 6% + bensulfuron methyl 0.6% @ 10 kg granules ha^{-1} as PE at 3 DAT), T_4 (pyrazosulfuron ethyl @ 20 g a.i. ha^{-1} as PE at 3 DAT followed by manual weeding at 25 DAT).



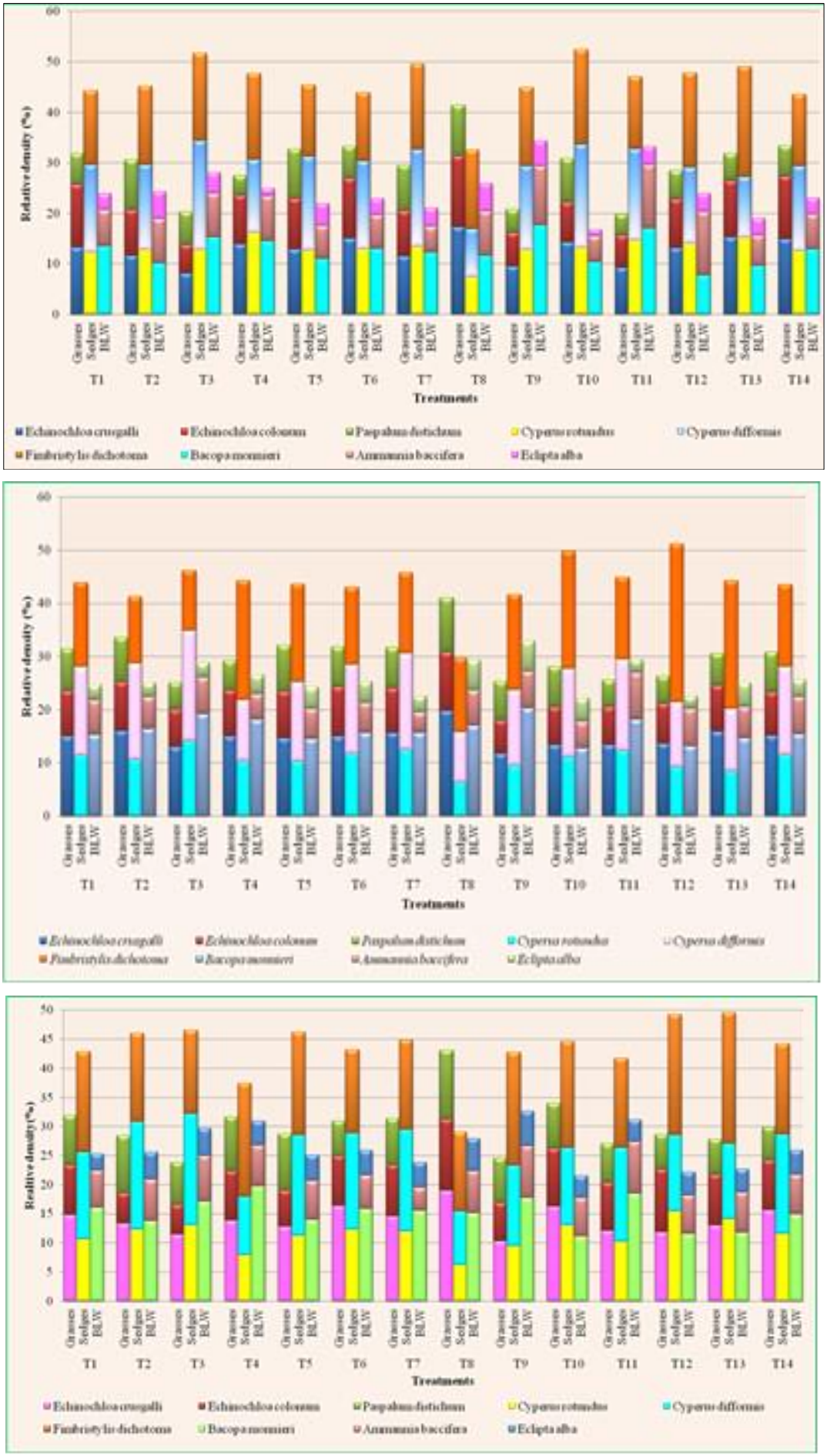
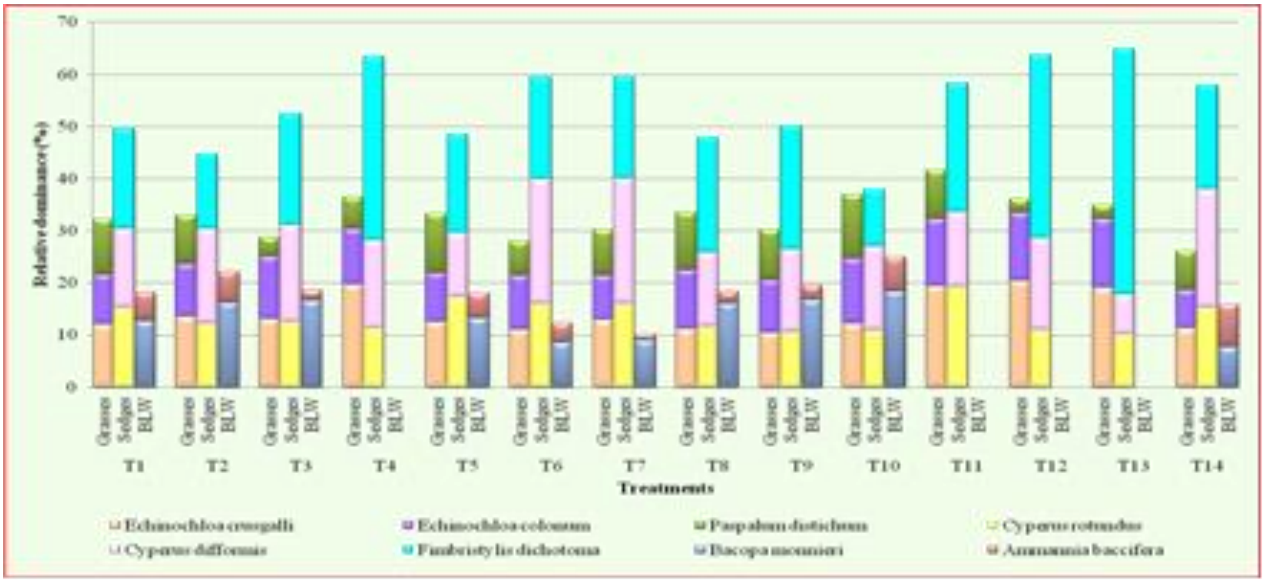


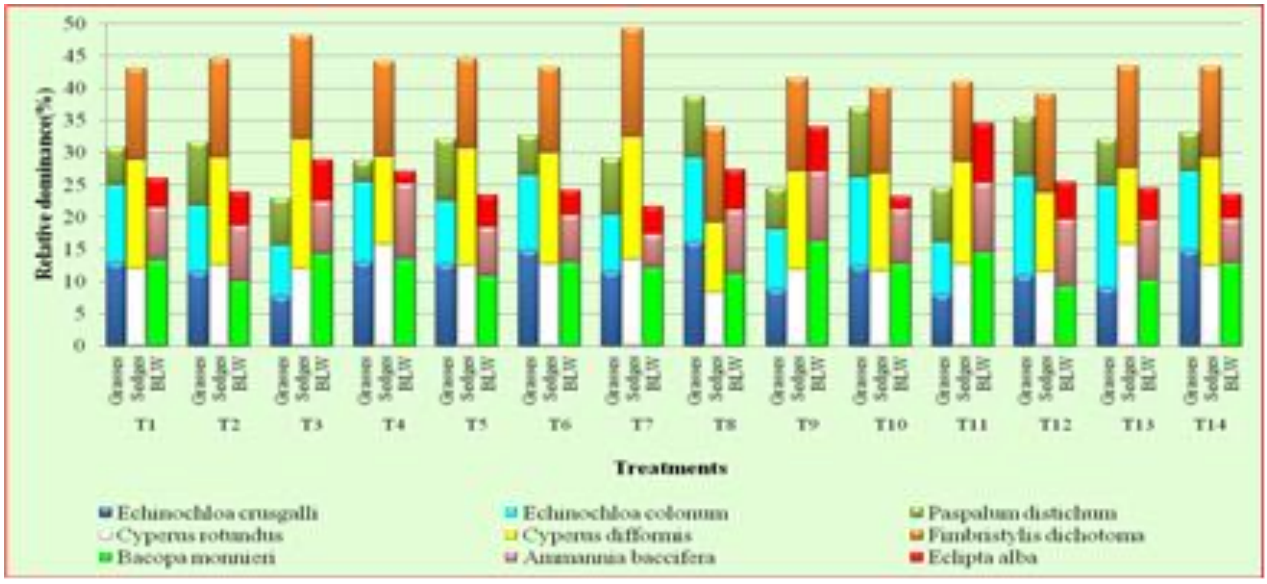
Fig 1, 2: Relative density of weeds in rice as influenced by weed management practices at 30 DAT, 60 DAT, 90 DAT and at harvest (2013 and 2014 Mean)

T_{11}(pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT followed by ethoxysulfuron @ 18.75 g a.i. ha^{-1} as PoE at 25 DAT), T_{12} (pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT followed by metsulfuron methyl + chlorimuron ethyl @ 4 g a.i. ha^{-1} as PoE at 25 DAT) and T_{13} (hand weeding twice at 25 and 45 DAT). Relative density of broad leaved weeds was continued to increase in all treatments and additional species that were present at 30 DAT was *Eclipta alba*.

At 90 DAT relative density of sedges was decreased in all the treatments. Relative density of grasses was increased in T_1 (pretilachlor @ 600 g a.i. ha^{-1} as PE at 3 DAT), T_4 (pyrazosulfuron ethyl @ 20 g a.i. ha^{-1} as PE at 3 DAT followed by manual weeding at 25 DAT), T_8 (azimsulfuron @ 35 g a.i. ha^{-1} as PoE at 25 DAT), T_{10} (bispyribac sodium @ 20 g a.i. ha^{-1} + metsulfuron methyl + chlorimuron ethyl @ 4 g a.i. ha^{-1} as PoE at 25 DAT), T_{11} (pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT followed by ethoxysulfuron @ 18.75 g a.i. ha^{-1} as PoE at 25 DAT) and T_{12} (pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT followed by metsulfuron methyl + chlorimuron ethyl @ 4 g a.i. ha^{-1} as PoE at 25 DAT). Relative density of broad leaved weeds was increased in all treatments except T_9 (bispyribac sodium @ 25 g a.i. ha^{-1} + ethoxysulfuron @ 18.75 g a.i. ha^{-1} as PoE at 25 DAT, T_{11} (pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT followed by ethoxysulfuron @ 18.75 g a.i. ha^{-1} as PoE at 25 DAT) and T_{12} (pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT followed by metsulfuron methyl + chlorimuron ethyl @ 4 g a.i. ha^{-1} as PoE at 25 DAT).

At harvest relatively higher density of sedges followed by grasses and broad leaf weeds. Sedge weed density continued to increase in all treatments indicating the natural dominance of sedge in the experimental site except T_8 (azimsulfuron @ 35 g a.i. ha^{-1} as PoE at 25 DAT) which excellently controlled sedges. In the treatments of T_4 (pyrazosulfuron ethyl @ 20 g a.i. ha^{-1} as PE at 3 DAT followed by manual weeding at 25 DAT), T_9 (bispyribac sodium @ 25 g a.i. ha^{-1} + ethoxysulfuron @ 18.75 g a.i ha^{-1} as PoE at 25 DAT, T_{11} (pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT followed by ethoxysulfuron @ 18.75 g a.i. ha^{-1} as PoE at 25 DAT), T_{12} (pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT followed by metsulfuron methyl + chlorimuron ethyl @ 4 g a.i. ha^{-1} as PoE at 25 DAT) and T_{13} (hand weeding twice at 25 DAT and 45 DAT) the grass weed density decreased due to application of PoE herbicides and weeding twice in T_{13}. In case of hand weeding twice at 25 and 45 DAT reduced the density of weed load upto the end of the season compared to other treatments was due to the manual removal of the weeds during early stages. Relative density of broad leaved weeds was increased in all treatments except T_8, T_9, T_{10}, T_{12}, and T_{13}.





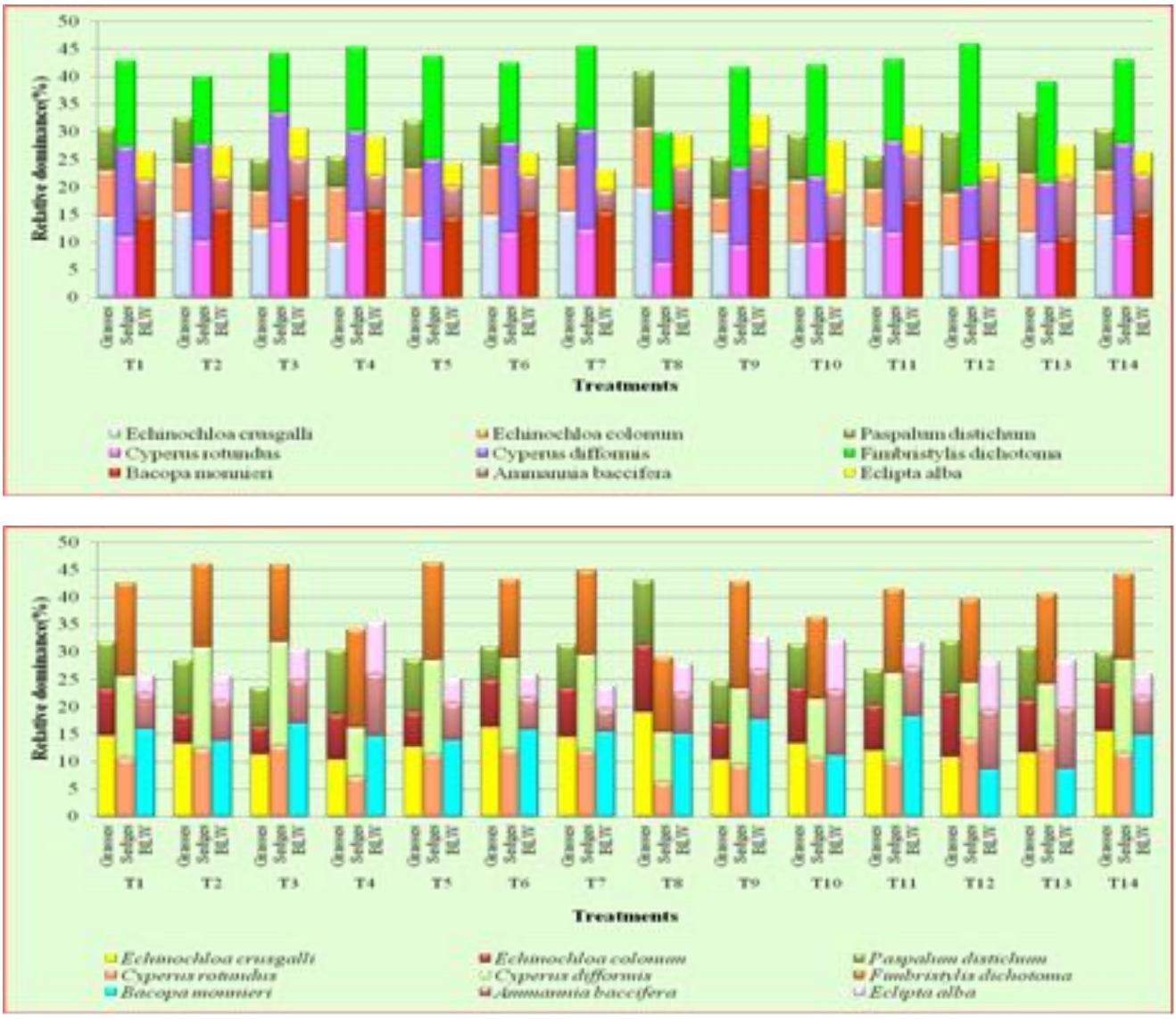


Fig 2: Relative dominance of weeds in rice as influenced by weed management practices at 30 DAT, 60 DAT, 90 DAT and at harvest (2013 and 2014 Mean)

Relative dominance of weeds (Figure 2)

At 30 DAT relative dominance of sedge weeds consisting of *Fimbristylis dichotoma*, *Cyperus rotundus* and *Cyperus difformis* were more in all the treatments compared to grasses and broad leaved weeds. The reduced dominance in T_4 (pyrazosulfuron ethyl @ 20 g a.i. ha^{-1} as PE at 3 DAT followed by manual weeding at 25 DAT), T_3 (pretilachlor 6% + bensulfuron methyl 0.6% @ 10 kg granules ha^{-1} as PE at 3 DAT), T_{11} (pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT followed by ethoxysulfuron @ 18.75 g a.i. ha^{-1} as PoE at 25 DAT), T_{12} (pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT followed by metsulfuron methyl + chlorimuron ethyl @ 4 g a.i. ha^{-1} as PoE at 25 DAT) and T_{13} (hand weeding twice at 25 DAT and 45 DAT) might be due to PE application of herbicide / PoE herbicides or manual weeding. Relative dominance of grass weeds was higher in the treatments T_{11} (pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT followed by ethoxysulfuron @ 18.75 g a.i. ha^{-1} as PoE at 25 DAT). Among the grasses *Echinochloa crusgalli* was more dominant. The broad leaved species observed were *Ammannia baccifera* and *Bacopa monnieri*. The dominance of *Bacopa monnieri* was more than *Ammannia baccifera*. There was no broad leaved weed species in treatments T_4, T_{11}, T_{12} and T_{13} while the relative dominance of broad leaf weeds was more in T_{10} (bispyribac sodium @ 20 g a.i. ha^{-1} + metsulfuron methyl + chlorimuron ethyl @ 4 g a.i. ha^{-1} as PoE at 25 DAT).

At 60 DAT increase in relative dominance of broad leaf weeds and grasses was also observed in addition to sedges present at 30 DAT. Relative dominance of sedges was decreased in T_8 treatment due to effect of azimsulfuron. Relative dominance of grasses was increased in T_6 (cyhalofop-p-butyl @ 100 g a.i. ha^{-1} as early PoE 12 DAT), T_8 (azimsulfuron @ 35 g a.i. ha^{-1} as PoE at 25 DAT) and T_{14} (weedy check) over rest of the treatments. Relative dominance of broad leaved weeds was continued to increase in all treatments except T_{10} (bispyribac sodium @ 20 g a.i. ha^{-1} + metsulfuron methyl + chlorimuron ethyl @ 4 g a.i. ha^{-1} as PoE at 25 DAT) and additional species that were present at 30 DAT was *Eclipta alba*.

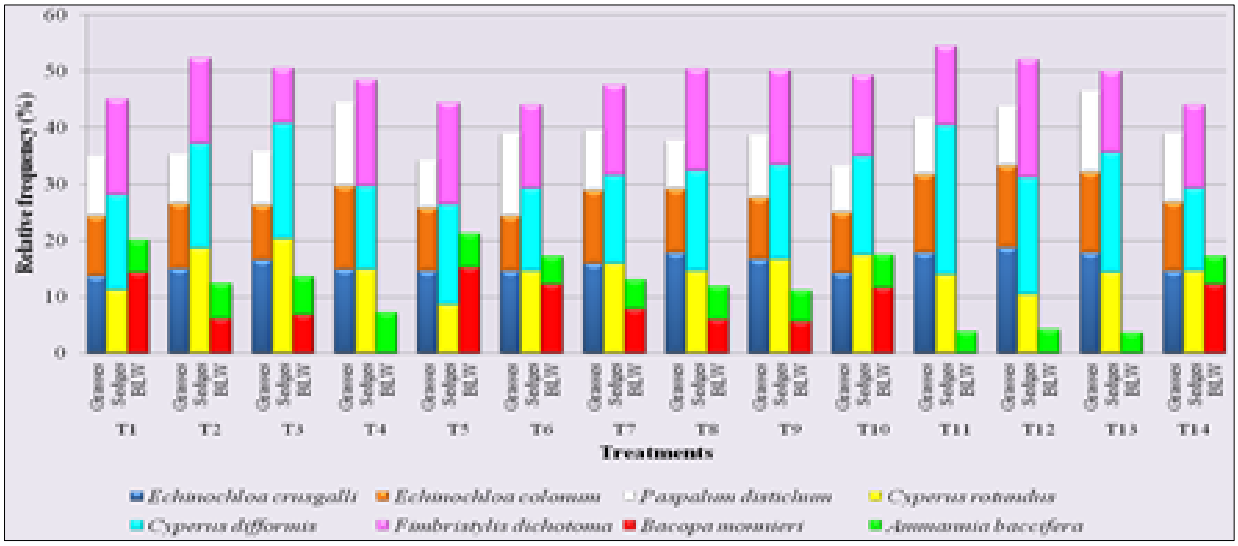
At 90 DAT increased relative dominance of grasses was continued with T_2 (pyrazosulfuron ethyl @ 20 g a.i. ha^{-1} 3 DAT), T_3 (pretilachlor 6% + bensulfuron methyl 0.6% @ 10 kg granules ha^{-1} as PE at 3 DAT), T_7 (bispyribac sodium @ 25 g a.i. ha^{-1} as PoE at 25 DAT), T_8 (azimsulfuron @ 35 g a.i. ha^{-1} as PoE at 25 DAT), T_9 (bispyribac sodium @ 25 g a.i. ha^{-1} + ethoxysulfuron @ 18.75 g a.i. ha^{-1} as PoE at 25 DAT), T_{11} (pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT followed by ethoxysulfuron @ 18.75 g a.i. ha^{-1} as PoE at 25 DAT) and T_{13} (hand weeding twice at 25 DAT and 45 DAT), however the

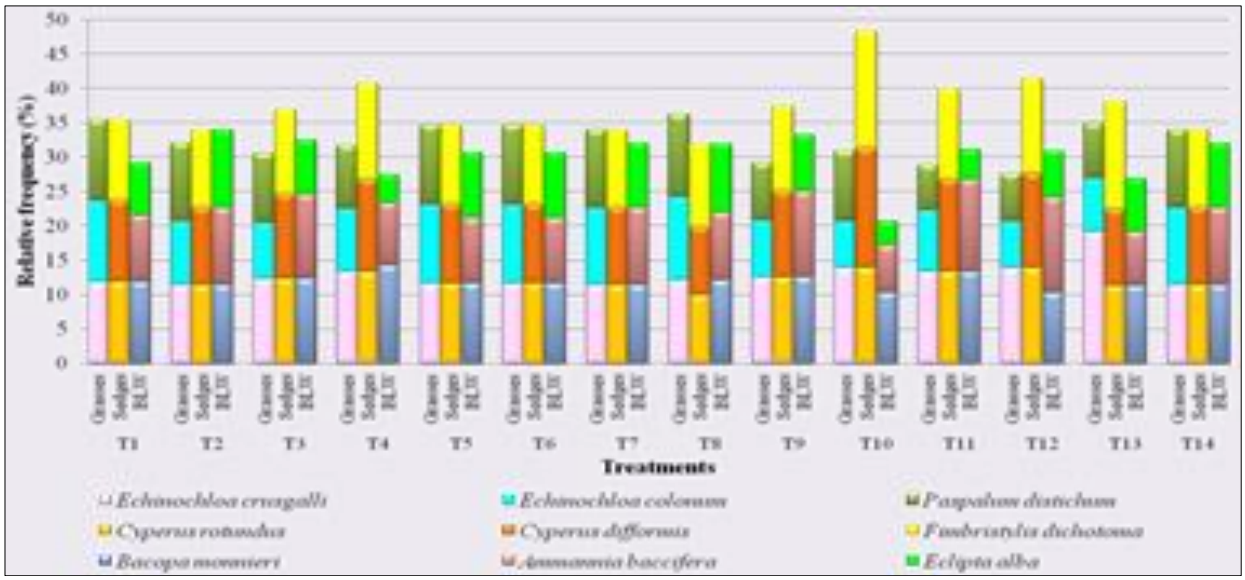
higher dominance of grasses was observed in T_8 (azimsulfuron @ 35 g a.i. ha^{-1} as PoE at 25 DAT). The increased dominance of grasses might be due to reduced efficacy of applied herbicides. Increased relative dominance of broad leaf weeds continued with all treatments.

At harvest slight increase in relative dominance of sedges was observed in all the treatments. However in weedy check almost equal dominance of grasses, sedges and broad leaf weeds was observed. Grass dominance was still continuing to increase with T_1 (pretilachlor @ 625 g a.i. ha^{-1} as PE at 3 DAT), T_4 (pyrazosulfuron ethyl @ 20 g a.i. ha^{-1} as PE at 3 DAT followed by manual weeding at 25 DAT), T_8 (azimsulfuron @ 35 g a.i. ha^{-1} as PoE at 25 DAT) and T_{10} (bispyribac sodium @ 20 g a.i. ha^{-1} + metsulfuron methyl + chlorimuron ethyl @ 4 g a.i. ha^{-1} as PoE at 25 DAT) treatments. The increase in relative dominance of broad leaf weeds was observed in T_4 (pyrazosulfuron ethyl @ 20 g a.i. ha^{-1} as PE at 3 DAT followed by manual weeding at 25 DAT), T_5 (penoxsulam @ 22.5 g a.i. ha^{-1} as early PoE at 12 DAT), T_{10} (bispyribac sodium @ 20 g a.i. ha^{-1} + metsulfuron methyl + chlorimuron ethyl @ 4 g a.i. ha^{-1}) as PoE at 25 DAT), T_{12} (pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT followed by metsulfuron methyl + chlorimuron ethyl @ 4 g a.i. ha^{-1} as PoE at 25 DAT) and T_{13} (hand weeding twice at 25 DAT and 45 DAT).

Relative Frequency (Figure 3)

At 30 DAT higher relative frequency of sedge weeds was observed in all the treatments with the higher relative frequency in T_{11} (pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT followed by ethoxysulfuron @ 18.75 g a.i. ha^{-1} as PoE at 25 DAT). The higher relative frequency of grass weeds was observed in T_{13} (hand weeding twice at 25 DAT and 45 DAT) and T_4 (pyrazosulfuron ethyl @ 20 g a.i. ha^{-1} as PE at 3 DAT followed by manual weeding at 25 DAT). Increased frequency of broad leaf weeds was observed with T_1 (pretilachlor @ 625 g a.i. ha^{-1} as PE at 3 DAT),





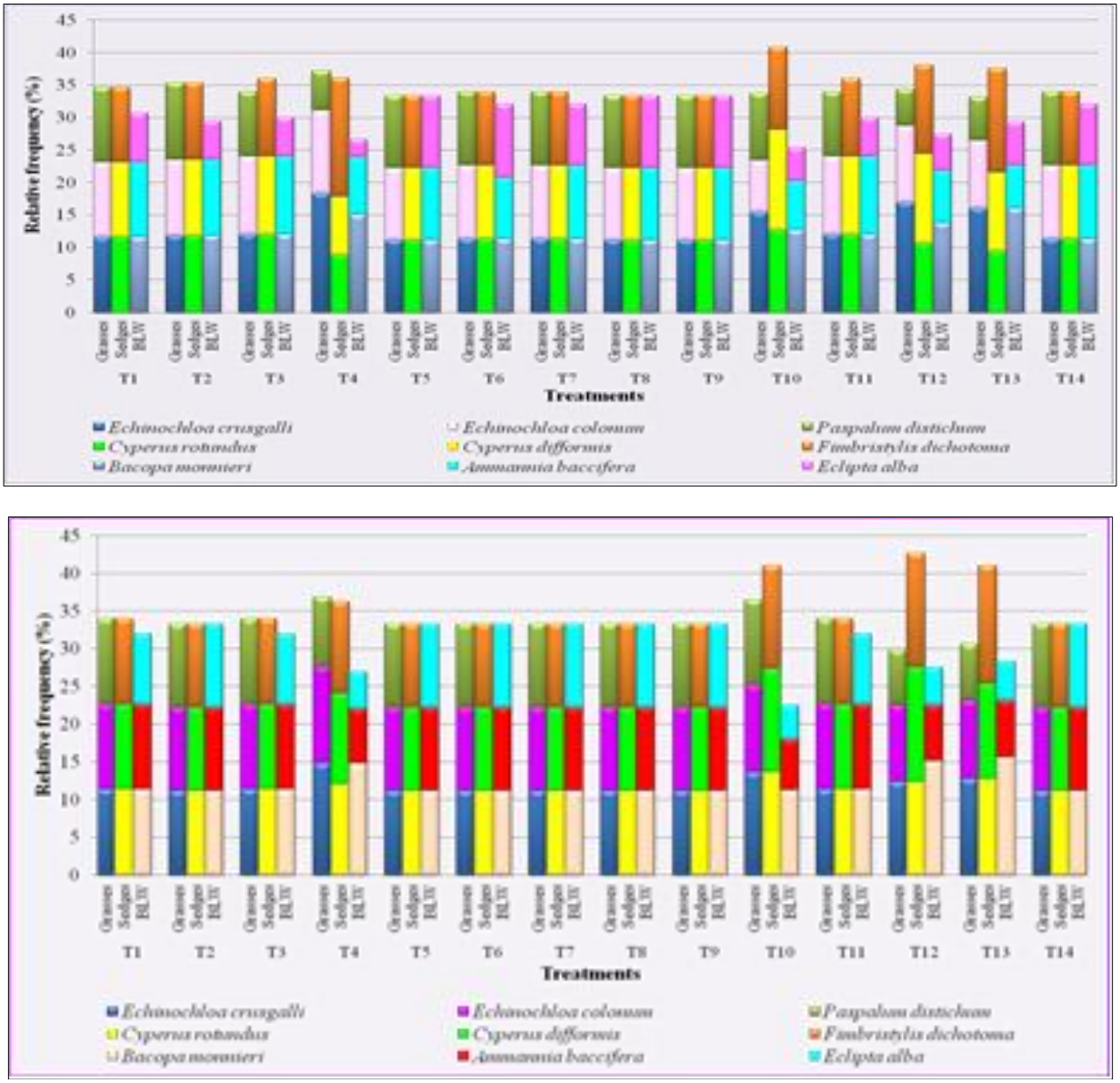


Fig 3: Relative frequency of weeds in rice as influenced by weed management practices at 30 DAT, 60 DAT, 90 DAT and at harvest (2013 and 2014 Mean)

T_5 (penoxsulam @ 22.5 g a.i. ha^{-1} as early PoE at 12 DAT) and T_{14} (weedy check), zero frequency of broad leaf weeds found in (pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT followed by ethoxysulfuron @ 18.75 g a.i. ha^{-1} as PoE at 25 DAT), T_{12} (pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT followed by metsulfuron methyl + chlorimuron ethyl @ 4 g a.i. ha^{-1} as PoE at 25 DAT) and T_{13} (hand weeding twice at 25 DAT and 45 DAT).

At 60 DAT increased relative frequency of grass weeds was continued with T_1 (pretilachlor @ 625 g a.i. ha^{-1} as PE at 3 DAT) and T_5 (penoxsulam @ 22.5 g a.i. ha^{-1} as early PoE at 12 DAT) treatments. However decreased relative frequency of sedges was observed in all the treatments, whereas increased frequency of broad leaved weds was observed in all the treatments.

At 90 DAT increased relative frequency of grass weeds was continued with T_2 (pyrazosulfuron ethyl @ 20 g a.i. ha^{-1} 3 DAT), T_3 (pretilachlor 6% + bensulfuron methyl 0.6% @ 10 kg granules ha^{-1} as PE at 3 DAT), T_4 (pyrazosulfuron ethyl @ 20 g a.i. ha^{-1} as PE at 3 DAT followed by manual weeding at 25 DAT), T_9 (bispyribac sodium @ 25 g a.i. ha^{-1} + ethoxysulfuron @ 18.75 g a.i. ha^{-1} as PoE at 25 DAT), T_{10} (bispyribac sodium @ 20 g a.i. ha^{-1} + metsulfuron methyl + chlorimuron ethyl @ 4 g a.i. ha^{-1} as PoE at 25 DAT), T_{11} (pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT followed by ethoxysulfuron @ 18.75 g a.i. ha^{-1} as PoE at 25 DAT) and T_{12} (pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT followed by metsulfuron methyl + chlorimuron ethyl @ 4 g a.i. ha^{-1} as PoE at 25 DAT) in turn T_8 (azimsulfuron @ 35 g a.i. ha^{-1} as PoE at 25 DAT) showed increased frequency sedge and was followed by T_2 (pyrazosulfuron ethyl @ 20 g a.i. ha^{-1} 3 DAT). At this stage increased relative frequency of broad leaf weeds was observed with T_{10} (bispyribac sodium @ 20 g a.i. ha^{-1} + metsulfuron methyl + chlorimuron ethyl @ 4 g a.i. ha^{-1} as PoE at 25 DAT), T_5 (penoxsulam @ 22.5 g a.i. ha^{-1} as early PoE at 12 DAT), T_6 (cyhalofop-p-butyl @ 100 g a.i. ha^{-1}) as early PoE 12 DAT), T_8 (azimsulfuron @ 35 g a.i. ha^{-1} as PoE at 25 DAT) and T_{13} (hand weeding twice at 25 DAT and 45 DAT) (Uma *et al*. 2014) [6].

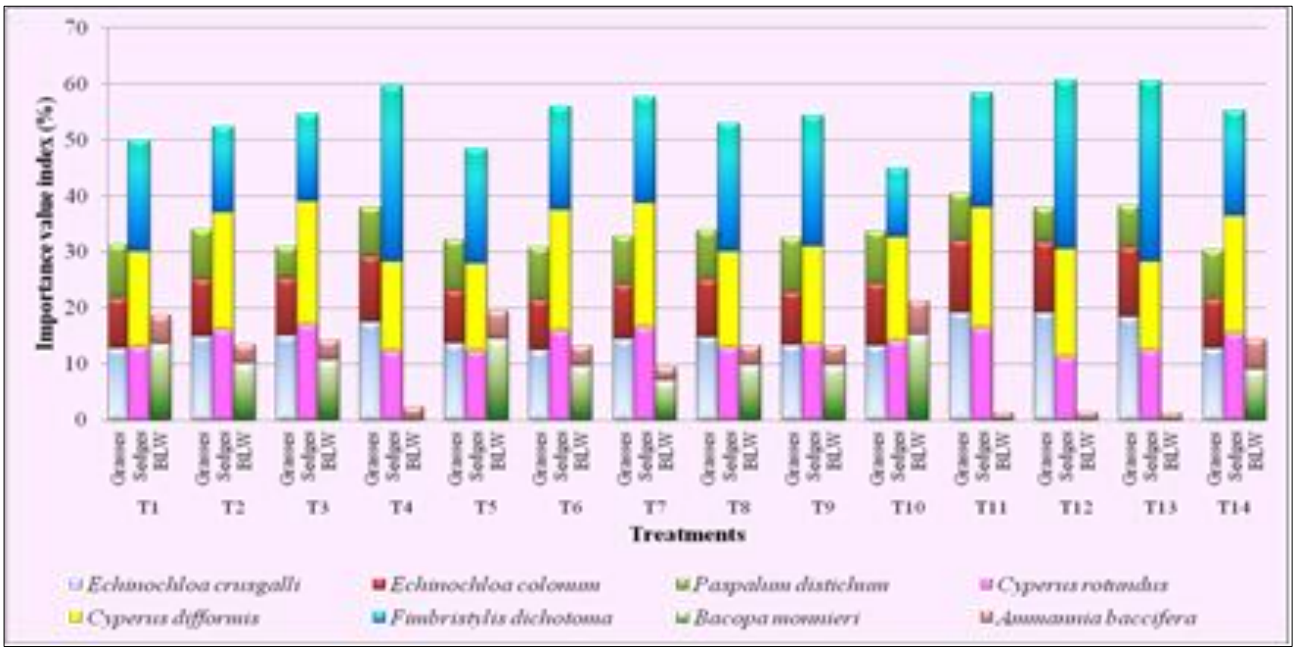
At harvest weed relative frequency of sedges was increased in T_{12} (pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT followed by metsulfuron methyl + chlorimuron ethyl @ 4 g a.i. ha^{-1} as PoE at 25 DAT) and T_{13} (hand weeding twice at 25 DAT and 45 DAT) treatments. Increased relative frequency of broad leaf weeds was observed in T_{10} (bispyribac sodium @ 20 g a.i. ha^{-1} + metsulfuron methyl + chlorimuron ethyl @ 4 g a.i. ha^{-1} as

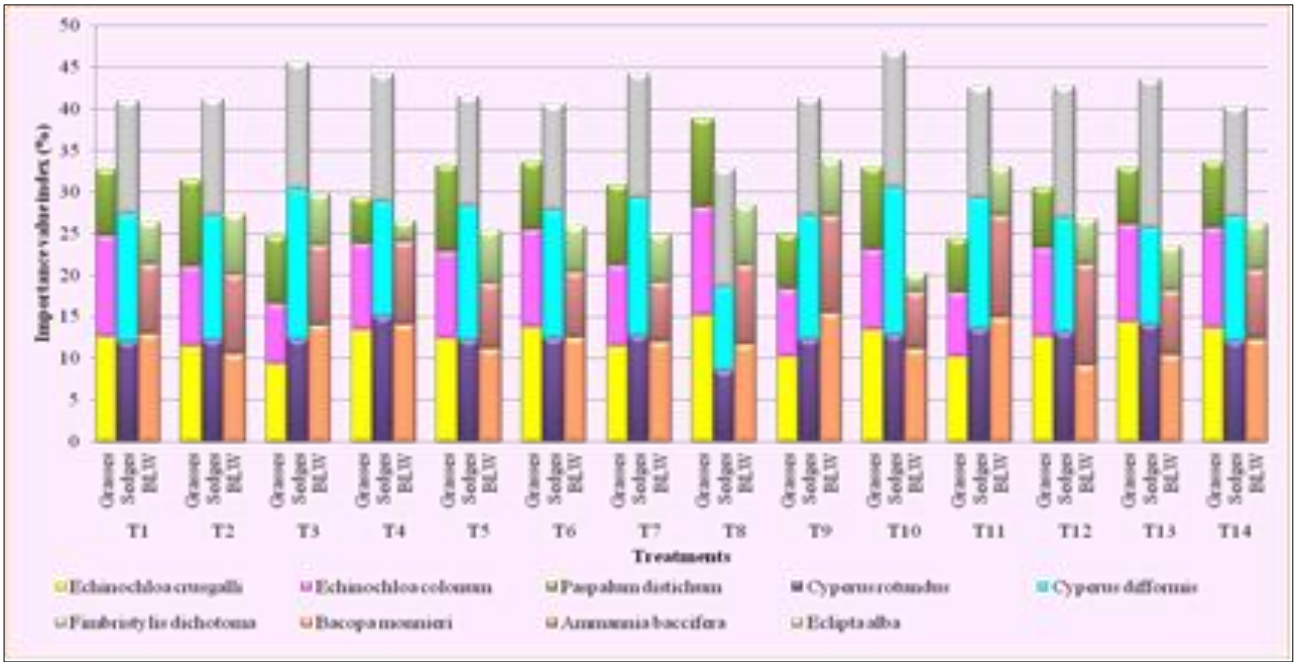
PoE at 25 DAT) and T_{13} (hand weeding twice at 25 DAT and 45 DAT) treatments.

Important value index (IVI) (Figure 4)

At 30 DAT during both the years of study higher IVI values of sedge weeds was noticed in all treatments compared to grasses and broad leaved weeds. Among the sedge weeds observed in different treatments *Fimbristylis dichotoma* was found to be ecologically more dominant species and was followed by *Cyperus rotundus and Cyperus difformis*. Among the grasses higher IVI values recorded with T_{13} (hand weeding twice at 25 DAT and 45 DAT), T_4 (pyrazosulfuron ethyl @ 20 g a.i. ha^{-1} as PE at 3 DAT followed by manual weeding at 25 DAT), T_{11} (pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT followed by ethoxysulfuron @ 18.75 g a.i. ha^{-1} as PoE at 25 DAT) and T_{10} (bispyribac sodium @ 20 g a.i. ha^{-1} + metsulfuron methyl + chlorimuron ethyl @ 4 g a.i. ha^{-1} as PoE at 25 DAT) with *Echinochloa crusgalli* as ecologically more dominant species. Among the broad leaved weeds higher IVI value was recorded with T_{14} (weedy check), T_5 (penoxsulam @ 22.5 g a.i. ha^{-1} as early PoE at 12 DAT), T_3 (pretilachlor 6% + bensulfuron methyl 0.6% @ 10 kg granules ha^{-1} as PE at 3 DAT) and T_1 (pretilachlor @ 625 g a.i. ha^{-1} as PE at 3 DAT) with *Bacopa monnieri* as ecologically more dominant weed species.

At 60 DAT ecological dominance of sedge weeds was continued and was followed by grasses and broad leaved weeds as noticed at 30 DAT, However a new broad leaved species of *Eclipta alba* was observed. Increased dominance of grasses and broad leaved weeds was observed over at 30 DAT with *Bacopa monnieri*, *Ammannia baccifera* as ecologically dominant species. Reduced dominance of *Cyperus difformis* was observed. At this stage also ecological dominance of same species was continued during both the years of study (Kabdal *et al*., 2014) [2].





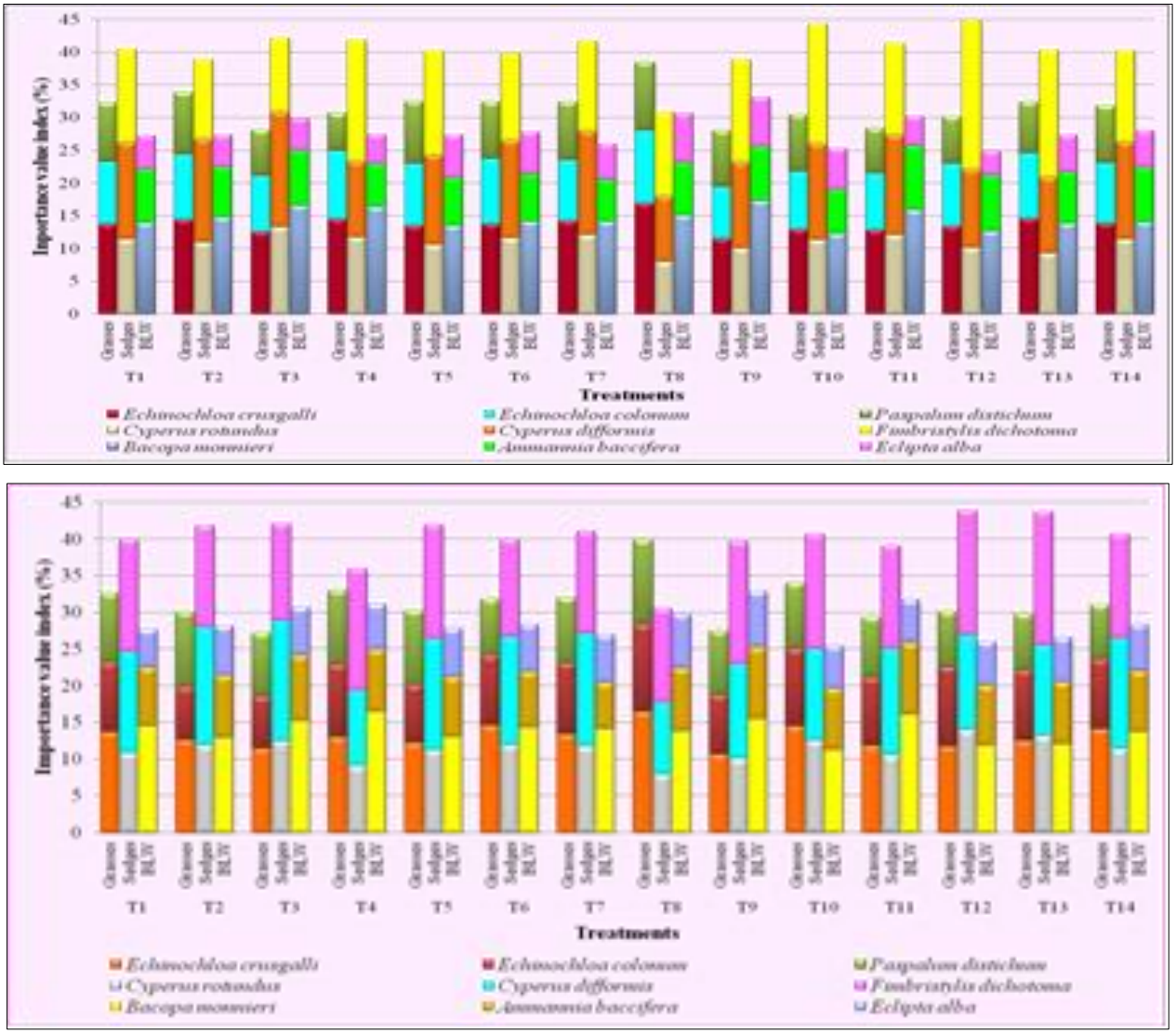


Fig 4: IVI of weeds in rice as influenced by weed management practices at 30 DAT, 60 DAT, 90 DAT and at harvest (2013 and 2014 Mean)

At 90 DAT increased ecological dominance of sedge species was as observed over 60 DAT with same species. Except in T_8 (azimsulfuron @ 35 g a.i. ha^{-1} as PoE at 25 DAT) where the sedge dominance decreased, grasses and broad leaved weeds increased. Ecological dominance of broad leaved weeds increased in T_1 (pretilachlor @ 625 g a.i. ha^{-1} as PE at 3 DAT), T_4 (pyrazosulfuron ethyl @ 20 g a.i. ha^{-1} as PE at 3 DAT followed by manual weeding at 25 DAT), T_6 (cyhalofop-p-butyl @ 100 g a.i. ha^{-1} as early PoE 12 DAT), T_7 (bispyribac sodium @ 25 g a.i. ha^{-1} as PoE at 25 DAT), T_8 (azimsulfuron @ 35 g a.i. ha^{-1} as PoE at 25 DAT), T_{10} (bispyribac sodium @ 20 g a.i. ha^{-1} + metsulfuron methyl + chlorimuron ethyl @ 4 g a.i. ha^{-1} as PoE at 25 DAT), T_{13} (hand weeding twice at 25 DAT and 45 DAT) and T_{14} (weedy check). Among the broad leaf weeds ecological dominance of *Bacopa monnieri* was continued.

At harvest increased ecological dominance of grasses was observed in T_4 (pyrazosulfuron ethyl @ 20 g a.i. ha^{-1} as PE at 3 DAT followed by manual weeding at 25 DAT), T_8 (azimsulfuron @ 35 g a.i. ha^{-1} as PoE at 25 DAT), T_{10} (bispyribac sodium @ 20 g a.i. ha^{-1} + metsulfuron methyl + chlorimuron ethyl @ 4 g a.i. ha^{-1} as PoE at 25 DAT) and T_{11} (pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT followed by ethoxysulfuron @ 18.75 g a.i. ha^{-1} as PoE at 25 DAT), among the grass species *Echinochloa crusgalli* was observed with higher IVI values at the end of the season. Increased ecological dominance of sedges was observed in T_2 (pyrazosulfuron ethyl @ 20 g a.i. ha^{-1} 3 DAT), T_5 (penoxsulam @ 22.5 g a.i. ha^{-1} as early PoE at 12 DAT), T_{13} (hand weeding twice at 25 DAT and 45 DAT) and T_{14} (weedy check). Among the broad leaved weeds increased ecological dominance of *Bacopa monnieri* was observed in T_1 (pretilachlor @ 625 g a.i. ha^{-1} as PE at 3 DAT), T_6 (cyhalofop-p-butyl @ 100 g a.i. ha^{-1} as early PoE 12 DAT) and T_{11} (pretilachlor @ 750 g a.i. ha^{-1} as PE at 3 DAT followed by ethoxysulfuron @ 18.75 g a.i. ha^{-1} as PoE at 25 DAT) treatments. Increased ecological dominance of *Ammannia baccifera* was observed in T_2, T_3, T_4, T_5, T_6, T_8, T_9, T_{10} and T_{13} treatments during both years of study.

Conclusion

Based on importance value index (IVI) *Bacopa monnieri* among broad leaf weeds, *Echinochloa crus-galli* among grasses and *Fimbristylis dichotoma* among sedges were ecologically more dominant weed species in experimental site.

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