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# EFFICIENCY OF HERBIGATION BASED WEED MANAGEMENT PRACTICES IN AEROBIC RICE

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**ABSTRACT**
A field trial was conducted during the summer season of 2015 at Zonal Agricultural Research Station, University of Agricultural Sciences (UAS), Gandhi Krishi Vignana Kendra (GKVK), Bengaluru, to find out the efficiency of herbigation based weed management practices in aerobic rice. The experiment consisted of 12 treatments laid out in randomized complete block design with three replications comprising pre-emergent herbigation of two herbicides at three doses integrated with one hand weeding, post emergent herbigation at two doses, post emergent herbigation with one hand weeding, one hand weeding and one intercultivation compared with weedy check and weed free check. Among different herbigation treatments pre-emergent herbigation of pretilachlor + bensulfuron methyl 6.6% GR @ 10 kg $ha^{-1}$ + one hand weeding + one intercultivation has recorded significantly higher number of productive tillers per hill (33.2), panicle length (25.8 cm), panicle weight (204.3 g $hill^{-1}$), total number of grains per panicle (291.0), weed control efficiency (84.09 %), grain yield (8954 kg $ha^{-1}$), straw yield (11371 kg $ha^{-1}$) and lower total weed density (4.33 No. 0.25 $m^{-2}$) and dry weight **(**0.83 g 0.25 $m^{-2}$ , respectively) followed by pre-emergent herbigation of pretilachlor + bensulfuron methyl 6.6% GR @ 10 kg $ha^{-1}$ + post emergent herbigation of bispyribac sodium 10% SC @ 200 ml $ha^{-1}$ + one hand weeding which were on par with each other and weed free check. Whereas, weedy check registered significantly lower number of productive tillers per hill (14.0), panicle length (20.6 cm), panicle weight (92.5 g $hill^{-1}$), total number of grains per panicle (207.7), grain yield (1379 kg $ha^{-1}$), straw yield (1676 kg $ha^{-1}$) and higher total weed density (39.67 No. 0.25 $m^{-2}$) and dry weight (14.50 g 0.25 $m^{-2,}$ respectively) and higher weed index (85.46 %)

**KEYWORDS:** Aerobic rice, herbigation, weed control efficiency, weed index.

## INTRODUCTION

Aerobic rice refers to growing of high yielding rice varieties in non puddled and non flooded aerobic soil. It entails the growing of rice in aerobic soil, with the use of external inputs such as supplementary irrigation, fertilizers and aiming at higher yields. In this method, land is brought to fine tilth under dry condition, the seeds were dibbled in definite rows with wider spacing and soil moisture regime is maintained almost around field capacity. However, the major constraints under aerobic soil condition to achieve higher yield is the weed infestation (Shanmuganathan, 2006). Weed infestation and competition is more severe in direct seeded rice as compared to transplanted rice, because the land is exposed during initial crop growth stages. Aerobic soil conditions and dry tillage practices besides alternate wetting and drying make the conditions more conducive for germination and growth of highly competitive grasses, sedges followed by dicots. Due to crop weed competition under aerobic conditions yield loss of 56.4 to 90.70 % in direct seeded upland rice is reported by Thakur and Bassi (1994) and Paradkar *et al.* (1997). In direct seeded rice, during the initial stage both rice and weed species germinate simultaneously and start compete severely with each other for the same pool of resources like light, water, nutrient and space from the time of emergence. To avoid this, early weed suppression is necessary to increase resource use efficiency and to achieve higher yields in aerobic rice. Though many methods have their own scope in weed control, appropriate and reliable methods will fetch good adoption. Chemical weed management is one such method provides ample opportunity for efficient weed management in aerobic rice. Optimizing the chemical weed management pracice is an important prerequisite for increasing the efficiency and the ecological soundness of food production. Since many years herbicides are applied as spray, which consumes lot of time and also threat to environment. Herbigation is the method of application of herbicides through irrigation water. If we follow this method through drip irrigation system we can address many problems like water scarcity, labour scarcity, environmental pollution etc. To the best of our knowledge, a very few studies in this line have so far been conducted. Therefore, the present study was undertaken with a view of evaluating the effect of herbigation practices on weed flora, weed dry weight and weed control efficiency in aerobic rice.

## MATERIALS & METHODS

### Site description

A field experiment was conducted during the summer season of 2015 at Zonal Agricultural Research Station, University of Agricultural Sciences (UAS), Gandhi Krishi Vignana Kendra (GKVK), Bengaluru, which is located between $12^{o}$ 51' N latitude and $77^{o}$ 35'E longitude and at an altitude of 930 m above mean sea level (MSL). The soil of the experimental site was red sandy clay loam in texture which is slightly acidic in reaction (pH: 6.28), medium in

available nitrogen (294.6 kg $ha^{-1}$), available phosphorus (44.2 kg $ha^{-1}$) and available potassium (233.2 kg $ha^{-1}$). The organic carbon content was medium (0.58 %). During the cropping season 479.5 mm of rainfall was received, in that April month recorded highest amount of rainfall (142.1 mm) and no rainfall in February. The mean maximum air temperature ranged between 27.4 $^{o}$C and 32.2 $^{o}$C whereas, mean minimum air temperature ranged between 15.2 °C and 21.0 °C.

**Experimental treatments and design**

Three herbicides *i.e.,* two pre emergence (pyrazosulfuron ethyl and pretilachlor + bensulfuron methyl) and one post emergent (bispyribac sodium) (Table 1) were included in the herbigation treatments along with hand weeding and intercultivation (Table 2). The experiment was laid out in randomized complete block design with three replications.

**TABLE 1:** Chemical formulation of herbicides with their herbicide group and mode of action

| Herbicide formulation | Chemical family | Mode of action |
|---|---|---|
| Pyrazosulfuron ethyl 10% WP | Sulfonyl urea | Acetolactate synthase (ALS) inhibitor |
| Pretilachlor + bensulfuron methyl 6.6% GR | Sulfonylurea | Inhibits meristematic tissue growth |
| Bispyribac sodium 10% SC | Pyrimidinlthio-benzoate | Acetolactate synthase (ALS) inhibitor, blocks branched chain amino acid biosynthesis |

Pre-emergent herbicides like pyrazosulfuron ethyl 10 % WP (in $T_1$, $T_2$ and $T_3$) and pretilachlor + bensulfuron methyl 6.6 % GR (in $T_4$, $T_5$, $T_6$, $T_7$, $T_8$, $T_9$ and $T_{10}$) on 2$^{nd}$ day of sowing (17$^{th}$ February, 2015) and post emergent herbicide bispyribac sodium 10% SC (in $T_7$, $T_8$ and $T_9$) at 23 DAS (11$^{th}$ March, 2015) were injected through drip irrigation ventury. Before herbigation soil was irrigated through drip for 30 minutes followed by herbigation for 10 minutes and plain irrigation again for 30 minutes was done in order to flush out the herbicide remained in the pipings.

**TABLE 2:** Treatment details used in the experiment

| Label | Treatment details |
|---|---|
| $T_1$ | PE herbigation of pyrazosulfuron ethyl 10% WP @ 250 g $ha^{-1}$ + one HW |
| $T_2$ | PE herbigation of pyrazosulfuron ethyl 10% WP @ 375 g $ha^{-1}$ + one HW |
| $T_3$ | PE herbigation of pyrazosulfuron ethyl 10% WP @ 500 g $ha^{-1}$ + one HW |
| $T_4$ | PE herbigation of pretilachlor + bensulfuron methyl 6.6% GR @ 10 kg $ha^{-1}$ + one HW |
| $T_5$ | PE herbigation of pretilachlor + bensulfuron methyl 6.6% GR @ 15 kg $ha^{-1}$ + one HW |
| $T_6$ | PE herbigation of pretilachlor + bensulfuron methyl 6.6% GR @ 20 kg $ha^{-1}$ + one HW |
| $T_7$ | PE herbigation of pretilachlor + bensulfuron methyl 6.6% GR @ 10 kg $ha^{-1}$ + PoE herbigation of bispyribac sodium 10% SC @ 200 ml $ha^{-1}$ |
| $T_8$ | PE herbigation of pretilachlor + bensulfuron methyl 6.6% GR @ 10 kg $ha^{-1}$ and PoE herbigation of bispyribac sodium 10% SC @ 300 ml $ha^{-1}$ |
| $T_9$ | PE herbigation of pretilachlor + bensulfuron methyl 6.6% GR @ 10 kg $ha^{-1}$ + PoE herbigation of bispyribac sodium 10% SC @ 200 ml $ha^{-1}$ + one HW |
| $T_{10}$ | PE herbigation of pretilachlor + bensulfuron methyl 6.6% GR @ 10 kg $ha^{-1}$ + one HW + one intercultivation |
| $T_{11}$ | Weedy check |
| $T_{12}$ | Weed free check |

**Note: PE:** Pre-emergent **PoE:** Post emergent **HW:** Hand weeding

**Crop husbandry**

The experiment was conducted by using rice hybrid KRH 4, which was developed at University of Agricultural Sciences, Bengaluru. It is a medium tall and attaining a plant height of 110-115 cm. The grain quality is medium fine, non-aroma, non-shattering and attains maturity in 135 to 140 days. The yield potential ranges from 9-10 MT $ha^{-1}$**.** Seeds were sown in the plots of 4.00 m x 4.00 m (16.00 $m^2$) at the spacing of 25 cm x 25 cm. The land was well prepared by dry ploughing followed by harrowing. FYM @ 10 t $ha^{-1}$ was applied for all the treatments 15 days prior to sowing. Recommended fertilizer (100: 50: 50 Kg NPK $ha^{-1}$) was adopted in the study. Phosphatic fertilizer (SSP) was applied basically at the time of sowing. The nitrogen (Urea) and potassium (MOP) was applied weekly twice through fertigation in equal split up to 90 days. Crop was irrigated through drip system regularly in order to maintain the soil moisture status. Poison bait was kept randomly in the field at grain filling stage to avoid rat menace.

**Data collection**

The weed count of grasses, sedges and broad leaved weeds and their total was recorded separately at 20, 40 and 60 DAS from 0.5 m X 0.5 m quadrant randomly selecting in the net plot area, later they were removed, oven dried at 65$^{0}$C and dry weight was recorded after attaining the constant weight and expressed in g 0.25 $m^{-2}$. At harvest total weed dry weight in net plot was recorded and weed control efficiency (Patel *et al.,* 1987) was calculated.

$$WCE\ (\%) = \frac{DMC - DMT}{DMC} X\ 100$$

Where,

WCE = Weed control efficiency (%)
DMC = Dry matter of weeds in weedy check plot (g)
DMT =Dry matter of weed in treated plots (g)

Crop was harvested as the ear heads turned brownish colour coupled with yellowish colour straw in more than 90 per cent plants. Grain and straw yield was recorded from the net plot area then later converted to kg $ha^{-1}$. In order to know the reduction in crop yield due to crop weed competition as compared to weed free plots, weed index (Gill and Vijaya Kumar 1969) was worked out by using the formulae.

$$WI\ (\%) = \frac{X - Y}{X} X\ 100$$

Where,

WI = Weed index (%)
X = Grain yield of weed free plot (kg $ha^{-1}$)
Y = Grain yield of treated plot (kg $ha^{-1}$)

**Statistical analysis**

The experimental data collected on crop and weed growth parameters was subjected to Fisher's method of "Analysis of Variance" (Panse and Sukhatme 1967). Wherever, F-test was significant an appropriate value of critical difference (C.D.) was worked out for comparison among the treatment means, otherwise, against C.D. values NS (Non-significant) was indicated. The results were presented and discussed at a probability level of five per cent. Correlation matrix was worked out between the various characters and grain yield. Since the data on weed count and weed dry weight were not normally distributed, the data were subjected to square root transformation using the formulae $\sqrt{x} + 0.25$

**RESULTS & DISCUSSION**

The various observations made on weeds and crop namely weed density, dry weight of weeds, weed index and weed control efficiency besides yield, yield parameters and correlation studies of aerobic rice as influenced by various treatments are presented in Table 3, 4 & 5.

**Effect on weeds**

The predominant weed flora observed in the experimental field in association with the aerobic rice includes grasses like, *Echinochloa colonum, Panicum repens, Digitaria marginata, Elusina indica, Chloris barbata, Cynadon dactylon* and *Dactyloctenium aegyptium*. Among broad leaved weeds, *Boreria hispida*, *Ageratum conyzoides, Commelina benghalensis, Spilanthus acmella, Acanthospermum hispidum, Mollugo disticha, Phyllanthus niruri, Portulaca oleraceae, Cynotis axillaries, Stachytarpheta indica, Mimosa pudika, Seteria glauca, Celosia argentia, Parthenium hysterophorus, Aeschynomene indica* and among sedges *Cyperus rotundus* were noticed. Similar weed species under direct seeded upland rice were also reported by Sanjoy Saha *et al*. (2005), Mishra and Singh (2007), Singh *et al.* (2005), Sunil (2010), Madhukumar (2011) and Jagadish (2015).

Weed control efficiency (WCE) denotes the magnitude of reduction in weed dry weight due to weed control treatments. Among different herbigation treatments pre-emergent herbigation of pretilachlor + bensulfuron methyl 6.6% GR @ 10 kg $ha^{-1}$ + one hand weeding + one intercultivation has recorded higher weed control efficiency at harvest (84.09 %) which was followed by pre-emergent herbigation of pretilachlor + bensulfuron methyl 6.6% GR @ 10 kg $ha^{-1}$+ post emergent herbigation of bispyribac sodium 10% SC @ 200 ml $ha^{-1}$ + one hand weeding (75.04 %) compared to weedy check. This was due to better control of weeds during crop growth period which results in lower total weed population and its dry weight. However, lower weed control efficiency among herbigation treatments was noticed with pre-emergent herbigation of pyrazosulfuron ethyl 10% WP @ 250 g $ha^{-1}$ + one hand weeding (43.68 %) followed by pre-emergent herbigation of pyrazosulfuron ethyl 10% WP @ 375 g $ha^{-1}$ + one hand weeding (44.72 %). The lower weed control efficiency was due to poor control of weeds as a result recorded higher weed population and their dry weight. Weed suppression and better weed control efficiency through appropriate management practices has been reported by Sunil *et al*. (2011) and Madukumar (2011). Similarly weed suppression through herbigation has been proved by Jagadish (2015). The weed population and total dry weight of weeds differed significantly due to different herbigation treatments. Pre-emergent herbigation of pretilachlor + bensulfuron methyl 6.6% GR @ 10 kg $ha^{-1}$ + one hand weeding + one intercultivation recorded significantly lower grasses, sedge, broad leaved weeds population and their total dry weight (3.33, 0.00, 1.00 No. 0.25 $m^{-2}$ and 0.83 g 0.25 $m^{-2}$ at 40 DAS, respectively) followed by pre-emergent herbigation of pretilachlor + bensulfuron methyl 6.6% GR @ 10 kg $ha^{-1}$ + post emergent herbigation of bispyribac sodium 10% SC @ 200 ml $ha^{-1}$ + one hand weeding (3.67, 1.00, 1.67 No. 0.25 $m^{-2}$ and 0.95 g 0.25 $m^{-2}$ at 40 DAS, respectively) (Table 3). The reduced grasses, sedges, broad leaved weeds and their total dry weight in these treatments was due to effective suppression of the weeds at initial stages of crop growth, resulted in lower weed population and their total dry weight. Whereas, significantly higher population of grasses, sedges, broad leaved weeds and their total dry weight was registered in weedy check (17.67, 4.00, 18.00 No. 0.25 $m^{-2}$ and 14.50 g 0.25 $m^{-2}$ respectively) due to no control of weeds. Similar results were found by Sanjoy Saha (2009), Ramachandiran and Balasubramanian (2012).

**TABLE 3:** Effect of herbigation practices on weed population (No. 0.25 $m^{-2}$) and weed dry weight (g 0.25 $m^{-2}$) at 40 DAS in aerobic rice

| | Weed population (No. 0.25 $m^{-2}$) | | | | Weed dry weight (g 0.25 $m^{-2}$) | | | |
|---|---|---|---|---|---|---|---|---|
| **Treatments** | **Grasses** | **Sedges** | **BLW** | **Total** | **Grasses** | **Sedges** | **BLW** | **Total** |
| $T_1$ | 3.29* (10.67**) | 0.83 (0.67) | 3.55 (12.33) | 4.89 (23.67) | 1.18* (1.13**) | 0.56 (0.07) | 1.24 (1.28) | 1.65 (2.48) |
| $T_2$ | 2.99 (8.67) | 0.50 (0.00) | 3.32 (11.00) | 4.45 (19.67) | 1.14 (1.05) | 0.50 (0.00) | 1.18 (1.15) | 1.57 (2.20) |
| $T_3$ | 2.69 (7.00) | 0.50 (0.00) | 2.73 (7.33) | 3.81 (14.33) | 1.08 (0.92) | 0.50 (0.00) | 1.03 (0.82) | 1.41 (1.73) |
| $T_4$ | 2.60 (6.67) | 1.04 (1.00) | 2.51 (6.33) | 3.76 (14.00) | 1.07 (0.89) | 0.59 (0.10) | 0.97 (0.70) | 1.39 (1.69) |
| $T_5$ | 2.49 (6.00) | 0.71 (0.33) | 1.81 (3.33) | 3.11 (9.67) | 1.02 (0.81) | 0.53 (0.03) | 0.90 (0.57) | 1.28 (1.41) |
| $T_6$ | 2.87 (8.00) | 0.50 (0.00) | 2.93 (8.33) | 4.07 (16.33) | 1.10 (0.96) | 0.50 (0.00) | 1.11 (0.98) | 1.48 (1.95) |
| $T_7$ | 2.62 (6.67) | 0.50 (0.00) | 2.25 (5.00) | 3.43 (11.67) | 1.04 (0.84) | 0.50 (0.00) | 0.93 (0.61) | 1.30 (1.44) |
| $T_8$ | 2.12 (4.33) | 0.83 (0.67) | 1.56 (2.33) | 2.71 (7.33) | 1.02 (0.79) | 0.56 (0.07) | 0.74 (0.30) | 1.19 (1.16) |
| $T_9$ | 1.98 (3.67) | 0.93 (1.00) | 1.27 (1.67) | 2.50 (6.33) | 0.96 (0.68) | 0.58 (0.10) | 0.64 (0.17) | 1.09 (0.95) |
| $T_{10}$ | 1.86 (3.33) | 0.50 (0.00) | 1.04 (1.00) | 2.10 (4.33) | 0.96 (0.67) | 0.50 (0.00) | 0.64 (0.17) | 1.03 (0.83) |
| $T_{11}$ | 4.23 (17.67) | 2.02 (4.00) | 4.27 (18.00) | 6.32 (39.67) | 3.02 (8.90) | 0.80 (0.40) | 2.33 (5.20) | 3.84 (14.50) |
| $T_{12}$ | 0.50 (0.00) | 0.50 (0.00) | 0.50 (0.00) | 0.50 (0.00) | 0.50 (0.00) | 0.50 (0.00) | 0.50 (0.00) | 0.50 (0.00) |
| S. Em.± | 0.16 | 0.23 | 0.28 | 0.24 | 0.03 | 0.04 | 0.04 | 0.05 |
| CD @ 5% | 0.46 | 0.68 | 0.82 | 0.71 | 0.10 | 0.13 | 0.11 | 0.13 |

**Note: * ($\sqrt{x}$ + 0.25) transformed** **PE:** Pre-emergent **** Figures in the parenthesis indicates original values** **PoE:** Post emergent
**HW:** Hand weeding. **DAS:** Days after sowing

**TABLE 4:** Productive tillers $hill^{-1}$, panicle length (cm), panicle weight (g $hill^{-1}$), total no. of grains $panicle^{-1}$, grain yield (kg $ha^{-1}$), straw yield (kg $ha^{-1}$), weed dry weight (kg $ha^{-1}$) at harvest, weed control efficiency (%) and weed index (%) in aerobic rice as influenced by herbigation practices

| Treatme-nts | Productive tillers $hill^{-1}$ | Panicle length (cm) | Panicle weight (g $hill^{-1}$) | Total No. of grains $panicle^{-1}$ | Grain yield (kg $ha^{-1}$) | Straw yield (kg $ha^{-1}$) | Weed dry weight (kg $ha^{-1}$) | Weed control efficiency (%) | Weed index (%) |
|---|---|---|---|---|---|---|---|---|---|
| $T_1$ | 25.1 | 21.4 | 176.4 | 251.7 | 7545 | 9066 | 6070 | 43.68 | 20.25 |
| $T_2$ | 26.1 | 21.6 | 170.5 | 253.0 | 7671 | 9230 | 5962 | 44.72 | 18.98 |
| $T_3$ | 29.1 | 22.3 | 180.9 | 265.7 | 8512 | 9996 | 4733 | 55.93 | 9.78 |
| $T_4$ | 29.5 | 22.5 | 184.9 | 270.7 | 8519 | 10186 | 4130 | 61.74 | 9.91 |
| $T_5$ | 31.1 | 23.2 | 193.1 | 277.3 | 8645 | 10693 | 3353 | 68.92 | 8.73 |
| $T_6$ | 28.0 | 21.8 | 180.5 | 261.0 | 8164 | 9800 | 5342 | 50.29 | 13.74 |
| $T_7$ | 30.2 | 22.9 | 190.5 | 273.2 | 8525 | 10279 | 3940 | 63.49 | 9.67 |
| $T_8$ | 31.5 | 23.3 | 195.7 | 284.3 | 8672 | 10808 | 3208 | 70.19 | 8.11 |
| $T_9$ | 32.1 | 25.7 | 197.5 | 288.8 | 8767 | 11085 | 2688 | 75.04 | 7.45 |
| $T_{10}$ | 33.2 | 25.8 | 204.3 | 291.0 | 8954 | 11371 | 1716 | 84.09 | 5.25 |
| $T_{11}$ | 14.0 | 20.6 | 92.5 | 207.7 | 1379 | 1676 | 10790 | 0.00 | 85.46 |
| $T_{12}$ | 35.3 | 26.1 | 215.1 | 302.0 | 9460 | 12235 | 0 | 100.00 | 0.00 |
| S.Em.± | 1.14 | 0.91 | 6.56 | 10.61 | 344 | 417 | - | 2.01 | 3.70 |
| CD @ 5% | 3.35 | 2.67 | 19.23 | 31.13 | 1010 | 1223 | - | 5.90 | 10.84 |

Higher weed control efficiency and lower weed index was recorded with pre-emergent herbigation of pretilachlor + bensulfuron methyl 6.6% GR @ 10 kg $ha^{-1}$ + one hand weeding + one intercultivation, followed by pre-emergent herbigation of pretilachlor + bensulfuron methyl 6.6% GR @ 10 kg $ha^{-1}$ + post emergent herbigation of bispyribac sodium 10% SC @ 200 ml $ha^{-1}$ + one hand weeding. This was mainly due to better control of weeds even upto harvest resulting in lower weed density and dry weight of weeds. Similar results were obtained by Madhukumar (2011) and Jagadish (2015).

**Effect on yield and yield and yield parameters**

Grain and straw yield differed significantly due to different herbigation treatments (Table 4). In the present investigation, yield loss recorded due to crop weed competition is to an extent of 85.46 per cent as indicated by weed index value. Weed free check and other herbigation treatments registered significantly higher grain and straw yield than weedy check. The higher grain and straw yield was recorded in weed free check (9460 and 12235 kg $ha^{-1}$ respectively) followed by pre-emergent herbigation of pretilachlor + bensulfuron methyl 6.6% GR @ 10 kg $ha^{-1}$ + one hand weeding + one intercultivation (8954 and 11371 kg $ha^{-1}$ respectively) and pre-emergent herbigation of pretilachlor + bensulfuron methyl 6.6% GR @ 10 kg $ha^{-1}$ + post emergent herbigation of bispyribac sodium 10% SC @ 200 ml $ha^{-1}$ + one hand weeding (8767 and 11085 kg $ha^{-1}$ ). The higher grain and straw yield in these treatments is mainly due to better control of weeds and higher weed control efficiency during early stage of crop growth which resulted in effective utilization of resources such as nutrients, moisture, space and light, inturn resulted in better expression of yield component *viz*., number of productive tillers per hill (35.3, 33.2 and 32.1 tillers $hill^{-1}$, respectively), panicle length **(**26.1, 25.8 and 25.7 cm, respectively), panicle weight **(**215.1, 204.3 and 197.5 g $hill^{-1}$, respectively) total Number of grains **(**302.0, 291.0 and 288.8 $panicle^{-1}$). Whereas, lower grain and straw yield was recorded with weedy check (1379 and 1676 kg $ha^{-1}$) because of severe crop weed competition which resulted in reduction in the expression of yield components such as productive tillers (14.0 $hill^{-1}$), panicle length **(**20.6 cm), panicle weight **(**92.5 g $hill^{-1}$) and total number of grains **(**207.7 $panicle^{-1}$). These results are in conformity with the findings of Sanjoy Saha (2005 & 2009) Singh *et al.* (2005), Sunil (2011) and Jagadish (2015).

**TABLE 5:** Correlation co-efficient (r) values of grain yield with yield and weed parameters of aerobic rice

| Correlation coefficient (r) | Grain yield | Productive tillers per hill | Panicle length (cm) | Panicle weight (g $hill^{-1}$) | Total number of grains per panicle | Total weed population | Weed dry weight |
|---|---|---|---|---|---|---|---|
| Grain yield | 1.00 | 0.95** | 0.60** | 0.97** | 0.90** | -0.90** | -0.88** |

**Significant at 1 % level

**Correlation studies**

There was a significant positive correlation (r values) of grain yield with productive tillers per hill (0.95), panicle length (0.60), panicle weight (0.97) and total number of grains per panicle (0.90). But there was negative correlation (r values) of grain yield with total weed population (-0.90) and weed dry weight (-0.88) (Table 5).

## CONCLUSION

The above study indicates pre-emergent herbigation of pretilachlor + bensulfuron methyl 6.6% GR @ 10 kg $ha^{-1}$ + one hand weeding + one intercultivation and pre-emergent herbigation of pretilachlor + bensulfuron methyl 6.6% GR @ 10 kg $ha^{-1}$ + post emergent herbigation of bispyribac sodium 10% SC @ 200 ml $ha^{-1}$ + one hand weeding have resulted higher grain and straw yield next to weed free check and significantly superior over weedy check.

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