Original Research Article

Influence of weed management practices on growth and yield of aerobic rice

Abstract

A field experiment was conducted at the Wetlands Farm of the Department of Farm Management, TamilNaduAgriculturalUniversitytoevaluatetheeffectofdifferentchemicalandnon-chemicalweedmanagementpracticesonaerobicrice.Preemergence(PE)applicationofpendimethalin (1.0kgha^{-1}), EPOEof bispyribacsodium (25 g ha^{-1}) and EPOEofchlorimuron ethyl +metsulfuronmethyl(4 gha^{-1}) were the chemical weed management practices. *Daincha* intercropping(1:1) *fb*spreadingon30DAS,Cowpea intercropping (1:1) *fb* spreading on 30DAS,Coir pith mulching (5tonsha^{-1})on 3DAS,Shreddedcoconutwastemulching(5tonsha^{-1})on3DAS along with the combination of mechanical and hand weeding were the non chemical weed management practices. Preemergence(PE)applicationofpendimethalin (1.0kgha^{-1})on3DAS*fb*Earlypostemergence(EPOE)applicationofbispyribacsodium(25gha^{-1})on 20DASsignificantly recordedhigher growth and yield attributes.Sequentialapplicationofpendimethalinandbispyribacsodiumrecorded 4128 kg ha^{-1} grain yield which was nearly60 percent increased over the weedycheck.Coir pith mulching @ 5 tons ha^{-1} on 3 DAS recorded significantly lower grain yield(1840 kg ha^{-1}) over the rest of the treatments.

Keywords: Aerobicrice,mulching,sequentialapplicationofherbicides, Pre emergence and Early post emergence

Introduction

Rice is an important staple food crop in the world. In India, it plays a vital role in meeting the nutritional demand of the nation. It is cultivated round the year in one or the other part of the country, in diverse ecologies spread over 44.6 M ha with a production of 132 MT of rice and average productivity of 2.96 t ha^{-1}.Rice is not exclusively a wetland plant (hydrophyte), but its growth in inundated conditions (5-10 cm water layer) is being practiced traditionally from time immemorial. The main agronomic advantages associated with this practice are the suppression of weeds, ease of ploughing and storage of water from heavy rainfall particularly during monsoon season (Datta *et al*., 2017).

Aerobic rice concept capitalizes on the advantages of the characteristics of rice varieties adopted in upland with less water requirement and irrigated varieties with high response to inputs. One of the major constraints which limit the yield of aerobic rice is that this crop suffers severely from weed infestations. In wetland ecosystem, rice has a 2-3 week 'head start' over weeds which complement the rice crop in competing weeds that have not emerged yet at transplanting. The continuous inundated water that exists after transplanting suppresses the

Comment [A1]: Include general objective at the beginning, Experimental design used, treatments (quantity and its repetitions), parameters evaluated, analyzes used and the most important results.

Comment [A2]: Include scientific name

Comment [A3]: Use citations not older than 10 years.

Include results of other previous studies, in addition the general objective is not observed at the end of the introduction

emergence and growth of most weed floraeffectively.Among all the rice growing eco systems, greatest weed pressure and competition occurs in aerobic rice system and the least in transplanted situation. Almost double the weed density and weed biomass was observed in aerobic rice field when compared to conventional transplanted condition (Mahajan *et al.*, 2011). Several methods are used for the management of weeds in aerobic rice. Herbicides have been increasingly and broadly applied in aerobic rice cultivation. Both pre-emergence herbicides, applied before crop emergence andpost-emergence herbicides, applied after crop emergence, can be used in aerobic ricefields, and are effective if they are properly used. In recent trends integrated weed management concept gives us wide and effective control of weeds.

Materials and Methods

Thefieldexperimentwasconductedinthe'B1'filedofWetlandFarmsofDepartmentof FarmManagement,TamilNaduAgriculturalUniversity,Coimbatoreduring*Kharif*seasonof 2017.Thefarmisgeographicallylocatedat11°Nlatitudeand77°Elongitudeatanaltitudeof 426.7mabovemeansealevel.CoimbatoreisintheWesternagroclimaticzoneof TamilNadu.Thesoiloftheexperimentalfieldwasneutralinreaction(pH:7.1),lowinavailableN (215.1kg ha^{-1})and high inavailable P(13.5 kg ha^{-1})andK(487.0 kg ha^{-1}). The experiment was laid out in randomized block design with12 treatments in 3 replications. Treatment details are T_1-PE applicationof pendimethalin(1.0kg ha^{-1}) on3 DAS *fb*HW on40DAS, T_2- EPOEof bispyribacsodium (25 g ha^{-1})on 20 DAS*fb*HW on40DAS, T_3- EPOEofchlorimuron ethyl + metsulfuronmethyl(4 gha^{-1}), T_4-PEapplicationofpendimethalin(1.0kgha^{-1})on3DAS*fb*EPOEofbispyribacsodium(25 gha^{-1})on20 DAS, T_5-Daincha intercropping(1:1) *fb*spreadingon30DAS, T_6 - Cowpea intercropping (1:1) *fb* spreading on 30DAS, T_7- Coir pith mulching (5tonsha^{-1})on 3DAS, T_8-Shreddedcoconutwastemulching(5tonsha^{-1})on3DAS, T_9 - Mechanical weeding on 20 and 40 DAS, T_{10}-Hand weedingon 20 and40 DAS, T_{11}-Mechanicalweedingon20DAS*fb*handweedingon40DAS and T_{12}-Weedy check.(HW - Hand weeding: MW - Mechanical weeding: DAS -Days after sowing: PE – Pre emergent: EPOE – Early postemergent).

The plant height of the tagged plants was measured from the ground level to the tip of the top most fully opened leaf or flag leaf at active tillering (AT) stage and panicle initiation (PI) up to the tip of the panicle at flowering and harvest stages and mean values were expressed in cm. Root volume per plant was measured after washing by volume displacement method and expressed in cc $plant^{-1}$. Root length was determined by measuring the length of root from the base of the culm to the tip of the lengthiest root and expressed in cm $plant^{-1}$.

The ear bearing tillers per quadrat (0.25 m^2) were counted randomly at four places in each net plot, pooled and expressed as number m^{-2}. The length of panicle was taken from ten panicles selected randomly from the tagged plant. It was measured from the neck-node to the tip of the apical grains. After this, the average length of panicle was determined and expressed in cm. The panicles selected for measuring length were weighed on an electrical weighing balance and then mean was worked out and expressed in g. The total numbers of filled grains and ill filled grains in the panicles were counted from the tagged plants and the mean was expressed as number panicle. From each net plot, one thousand well filled grains were collected at harvest.

Comment [A4]: More procedurally describe the experiment setup process so that readers can replicate the experiment

The grains were weighed in an electronic balance corrected to 14 per cent moisture level and expressed in g. The grain yield from each net plot area was recorded after threshing, cleaning, drying and winnowing. From that weight, the final grain yield was computed at 14 per cent moisture content and expressed in kg ha^{-1}. The dry weight of straw per net plot was recorded after sun drying for three days and expressed in kg ha^{-1}.

Results and discussion

Comment [A5]: Update references used.
Improve reference format
Improve considering material and methods

Effect of weed management practices on plant height

At PI stage, hand weeding on 20 and 40 DAS (T_{10}) recorded taller plants (89.2 cm) followed by PE application of pendimethalin (1.0 kg ha^{-1}) on 3 DAS *fb* EPOE application of bispyribac sodium (25 g ha^{-1}) on 20 DAS (T_4) (86.2 cm), PE application of pendimethalin (1.0 kg ha^{-1}) on 3 DAS *fb* HW on 40 DAS (T_1) (85.6 cm)and EPOE application of bispyribac sodium (25 g ha^{-1}) on 20 DAS *fb* HW on 40 DAS (T_2) (83.2 cm).Favourable environment created by weed free situation enhanced the plant height in these treatments. Coir pith mulching @ 5 tons ha^{-1} on 3 DAS (T_7) (71.3 cm), EPOE application of chlorimuron ethyl *fb* metsulfuron methyl (4 g ha^{-1}) (T_3) (80.1 cm) and other non-chemical weed management practices were on par with each other.

At flowering and maturity stages, though there was statistical difference among the treatments, they were only numerical. Hand weeding on 20 and 40 DAS (T_{10}) recorded taller plants (93.5 and 99.7 cm) followed by PE application of pendimethalin (1.0 kg ha^{-1}) on 3 DAS *fb* EPOE application of bispyribac sodium (25 g ha^{-1}) on 20 DAS (T_4) (91.1 and 96.1 cm). Coir pith mulching @ 5 tons ha^{-1} on 3 DAS (T_7) and weed check T_{12} (73.2 and 79.3 cm; 71.6 and 75.6 cm at flowering and maturity stages, respectively) registered lower plant height than other treatments.

Effect of weed management practices on root length

At AT, PI and flowering stages, hand weeding on 20 and 40 DAS (T_{10}) recorded higher root length (12.2, 18.9 and 22.9 cm) which was on par with the treatments,

PE application of pendimethalin (1.0 kg ha^{-1}) on 3 DAS *fb* EPOE application of bispyribac sodium (25 g ha^{-1}) on 20 DAS (T_4) (11.9, 18.7 and 22.7 cm, respectively), PE application of pendimethalin (1.0 kg ha^{-1}) on 3 DAS *fb* HW on 40 DAS (T_1) (11.7, 18.3 and 22.3 cm, respectively) and EPOE application of bispyribac sodium (25 g ha^{-1}) on 20 DAS *fb* HW on 40 DAS (T_2) (11.5, 17.9 and 21.8 cm on AT, PI and flowering stages, respectively).Coir pith mulching @ 5 tons ha^{-1} on 3 DAS (T_7) (7.2, 11.9 and 16.4 cm) and weedy check (T_{12}) (7.0, 11.7 and 16.2 cm on AT, PI and flowering stages, respectively) recorded lower root length and found to be significant.

Effect of weed management practices on root volume

Hand weeding on 20 and 40 DAS (T_{10}) recorded higher root volume at all the crop growth stages (14.8, 20.3 and 22.5 cc $plant^{-1}$ on AT, PI and flowering stages, respectively) which was comparable with, PE application of pendimethalin (1.0 kg ha^{-1}) on 3 DAS *fb* EPOE application of bispyribac sodium (25 g ha^{-1}) on 20 DAS (T_4) (14.5, 20.1 and 22.3 cc $plant^{-1}$, respectively), PE application of pendimethalin (1.0 kg ha^{-1}) on 3 DAS *fb* HW on 40 DAS(T_1) (14.3, 19.7 and 21.8 cc $plant^{-1}$, respectively) and EPOE application ofbispyribac sodium

(25 g ha^{-1}) on 20 DAS *fb* HW on 40 DAS (T_2) (14.1, 19.4 and 21.2 cc $plant^{-1}$, respectively).Coir pith mulching @ 5 tons ha^{-1} on 3 DAS (T_7) (9.3, 12.9 and 14.9 cc $plant^{-1}$, respectively) and weedy check (T_{12}) (8.8, 12.3 and 14.1 cc $plant^{-1}$ on AT, PI and flowering stages, respectively) recorded lower root volume than rest of the treatments.

Effect of weed management practices on productive and per cent unproductive tillers

The yield attribute, productive tillers per unit area was significantly influenced by different chemical and non-chemical weed management practices. Hand weeding on 20 and 40 DAS (T_{10}) recorded higher number of productive tillers (297.3 m^{-2}) with 12.8 per cent unproductive tillers, which was comparable with the treatments, PE application of pendimethalin (1.0 kg ha^{-1}) on3DAS *fb* EPOE application of bispyribac sodium

(25 g ha^{-1}) on 20 DAS (T_4) with 293.5 productive tillers m^{-2} and 12.8 per cent unproductive tillers, PE application of pendimethalin (1.0 kg ha^{-1}) on 3 DAS *fb* HW on 40 DAS (T_1) with 284.2 productive tillers m^{-2} with and 13.1 per cent unproductive tillers and EPOE application of bispyribac sodium (25 g ha^{-1}) on 20 DAS *fb* HW on 40 DAS (T_2) with 273.5 productive tillers m^{-2} with and 14.3 per cent unproductive tiller.Coir pith mulching @ 5 tons ha^{-1} on 3 DAS (T_7) registered lower number of productive tillers (121.3 m^{-2}) with higher per cent unproductive tillers (27.1 per cent) which was comparable with weedy check (T_{12}), which recorded 112.3 productive tillers m^{-2} having 29.9 per cent unproductive tillers.

Effect of weed management practices on total number of grains and filled grains per panicle

Hand weeding on 20 and 40 DAS (T_{10}) recorded higher number of grains per panicle (151.7) which was at par with PE application of pendimethalin (1.0 kg ha^{-1}) on 3 DAS *fb* EPOE application of bispyribac sodium (25 g ha^{-1}) on 20 DAS)(T_4)(150.2), PE application of pendimethalin (1.0 kg ha^{-1}) on 3 DAS *fb* HW on 40 DAS (T_1) (146.8), EPOE application of bispyribac sodium (25 g ha^{-1}) on 20 DAS *fb* HW on 40 DAS (T_2) (145.7). The increased number of productive tillers m^{-2}, filled grain $panicle^{-1}$ and panicle weight might be due to increase in the availability of nutrients, water, light and space to the crops as a result of effective control of weeds. This aligned with the findings of Gowda *et al.* (2009), Ramesh *et al.* (2009), Khaliq *et al*. (2011) and Mahajan *et al.* (2014). Shredded coconut waste mulching @ 5 tons ha^{-1} on 3 DAS (T_8) recorded lower number of grains per panicle (121.8) which was on par with coir pith mulching @ 5 tons ha^{-1} on 3 DAS (T_7) (117.2) and weedy check (T_{12}) (111.3).

Grain filling was considerably higher in hand weeding on 20 and 40 DAS (T_{10}) and chemical weed management treatments (except T_3), where hand weeding on 20 and 40 DAS (T_{10}) recorded 137.5 numbers of filled grains $panicle^{-1}$ with 90.6 per cent grain filling, which was on par with PE application of pendimethalin (1.0 kg ha^{-1}) on 3 DAS *fb* EPOE application of bispyribac sodium (25 g ha^{-1}) on 20 DAS (T_4) (136.0 grains $panicle^{-1}$) with 90.5 per cent grain filling, PE application of pendimethalin (1.0 kg ha^{-1}) on 3 DAS *fb* HW on 40 DAS (T_1) (130.6 grains $panicle^{-1}$) with 89.0 per cent grain filling and EPOE application of bispyribac sodium (25 g ha^{-1}) on 20 DAS *fb* HW on 40 DAS (T_2) (129.2 grains $panicle^{-1}$) with 88.7 per cent grain filling.Shredded coconut waste mulching @ 5 tons ha^{-1} on 3 DAS (T_8) recorded lower number of filled grain per panicle (93.7 grains $panicle^{-1}$) with 76.9 per cent grain filling which was

comparable with coir pith mulching @ 5 tons ha^{-1} on 3 DAS (T_7) (87.3 grains $panicle^{-1}$) with 74.5 per cent grain filling and weedy check (T_{12}) (82.2 grains $panicle^{-1}$) with 73.9 per cent grain filling.

Effect of weed management practices on test weight, panicle length and weight

There was no significant difference between different chemical and non-chemical weed management practices regarding panicle length and test weight.For panicle weight, hand weeding on 20 and 40 DAS (T_{10}) recorded higher panicle weight (2.9 g) and which was on par with PE application of pendimethalin (1.0 kg ha^{-1}) on 3 DAS *fb* EPOE application of bispyribac sodium (25 g ha^{-1}) on 20 DAS (T_4) (2.8 g).Substantial improvement in the sink could be achieved due to a conducive weed free condition to the crop by adoption of chemical weed management practices in combination with hand weeding or sequential application of two chemicals. Further the better growth environment in terms of availability of more space, light and nutrients by timely control of weeds might have also contributed to the increased values of yield attributes (Singh *et al*., 2000). Differences among each other was due to difference in weed controlling ability of the treatments. Weedy check (T_{12}) registered lower panicle weight (0.9 g) which was comparable with coir pith mulching @ 5 tons ha^{-1}on 3 DAS (T_7) (1.1 g) and shredded coconut waste mulching @ 5 tons ha^{-1} on 3 DAS (1.3 g).

Effect of weed management practices on grain and straw yield

Hand weeding on 20 and 40 DAS (T_{10}) recorded higher grain and straw yield (4298 and 5802 kg ha^{-1}) which was comparable with PE application of pendimethalin (1.0 kg ha^{-1}) on 3 DAS *fb* EPOE application of bispyribac sodium (25 g ha^{-1}) on 20 DAS (T_4) (4128 and 5697 kg ha^{-1}), PE application of pendimethalin (1.0 kg ha^{-1}) on 3 DAS *fb* HW on 40 DAS (T_1) (4031 and 5512 kg ha^{-1}) and EPOE application of bispyribac sodium (25 g ha^{-1}) on 20 DAS *fb* HW on 40 DAS (T_2) (3987 and 5389 kg ha^{-1} grain yield and straw yield, respectively).Higher grain yield might be attributed to the weed free environment provided by early control of weeds by PE application of pendimethalin/EPOE application of bispyribac sodium and subsequent establishment of weed free condition either manually or by spraying chemicals in the respective treatments at later stage. Coir pith mulching @ 5 tons ha^{-1} on 3 DAS (T_7) (1840 and 2840 kg ha^{-1} grain yield and straw yield, respectively).

Conclusion

A single weed management practice was not able to manage weeds effectively with higher crop growth. Herbicides offered the most effective way of weed management and ensured higher growth by the crop and ultimately increase in the yield. PE application of pendimethalin (1.0 kg ha^{-1}) on 3 DAS *fb* EPOE application of bispyribac sodium (25 g ha^{-1}) on 20 DAS was found to be effective in aerobic rice.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

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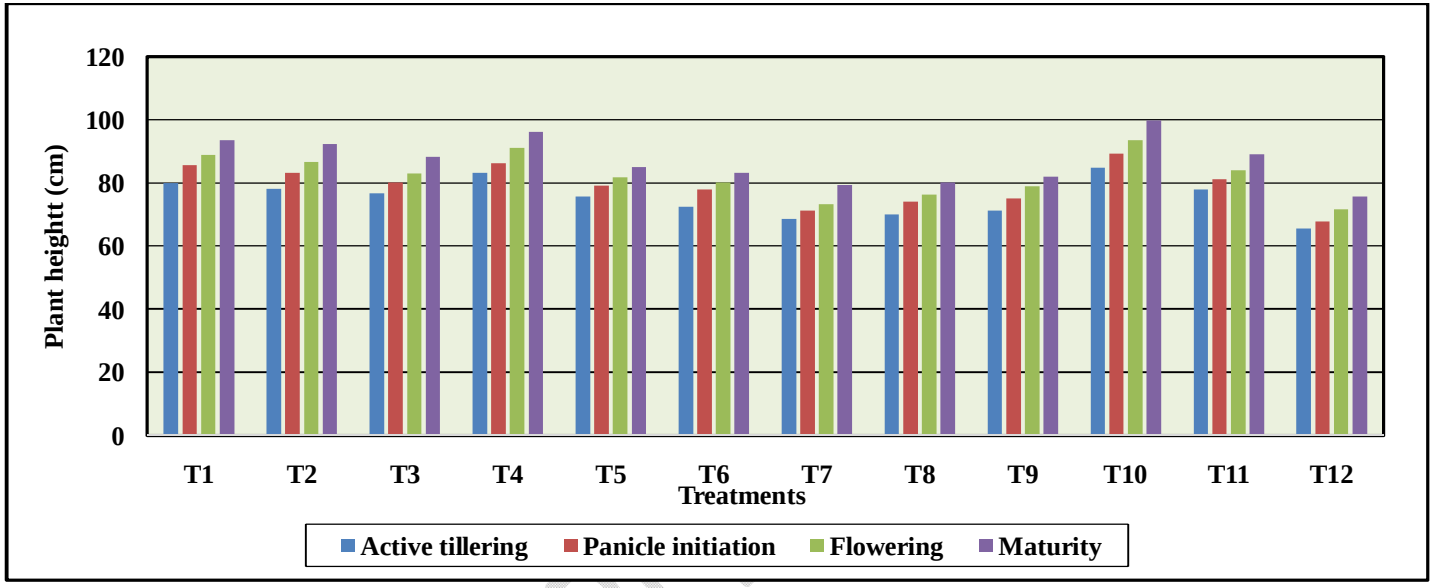

Fig. 1.Influence of chemical and non-chemical weed management practices on plant height of aerobic rice

Table 1.Influence of chemical and non-chemical weed management practices on root length (cm) of aerobic rice

Treatments	Active tillering	Panicle initiation	Flowering
T_1: PE pendimethalin (1 kg ha^{-1}) on 3 DAS *fb*hand weeding on 40 DAS	11.7	18.3	22.3
T_2: EPOE bispyribac sodium (25 g ha^{-1}) on 20 DAS *fb*hand weeding on 40 DAS	11.5	17.9	21.8
T_3: EPOE chlorimuron ethyl + metsulfuron methyl (4 g ha^{-1}) on 2-3 leaf stage of weeds	9.7	15.3	19.5
T_4: PE pendimethalin (1 kg ha^{-1}) on 3 DAS *fb*EPOE bispyribac sodium (25 g ha^{-1}) on 20 DAS	11.9	18.7	22.7
T_5: *Daincha* intercropping (1:1) *fb* spreading on 30 DAS	9.5	15.1	19.2
T_6: Cowpea intercropping (1:1) *fb* spreading on 30 DAS	9.2	14.9	18.9
T_7: Coir pith mulching (5 tons ha^{-1}) on 3 DAS	7.2	11.9	16.4
T_8: Shredded coconut waste mulching (5 tons ha^{-1}) on 3 DAS	8.7	14.3	18.3
T_9: Mechanical weeding on 20 and 40 DAS	9.1	14.7	18.7
T_{10}: Hand weeding on 20 and 40 DAS	12.2	18.9	22.9
T_{11}: Mechanical weeding on 20 DAS *fb*hand weeding on 40 DAS	9.9	15.5	19.8
T_{12}: Weedy check	7.0	11.7	16.2
SEd	**0.7**	**1.0**	**0.9**
CD (P=0.05)	**1.4**	**2.2**	**1.8**

(PE – Pre emergent, EPOE – Early Post Emergence application, DAS – Days after sowing, *fb* – followed by)

Table 2.Influence of chemical and non-chemical weed management practices on root volume (cc plant^{-1}) of aerobic rice

Treatments	Active tillering	Panicle initiation	Flowering
T_1: PE pendimethalin (1 kg ha^{-1}) on 3 DAS *fb*hand weeding on 40 DAS	14.3	19.7	21.8
T_2: EPOE bispyribac sodium (25 g ha^{-1}) on 20 DAS *fb*hand weeding on 40 DAS	14.1	19.4	21.2
T_3: EPOE chlorimuron ethyl + metsulfuron methyl (4 g ha^{-1}) on 2-3 leaf stage of weeds	11.9	16.9	18.5
T_4: PE pendimethalin (1 kg ha^{-1}) on 3 DAS *fb*EPOE bispyribac sodium (25 g ha^{-1}) on 20 DAS	14.5	20.1	22.3
T_5: *Daincha* intercropping (1:1) *fb* spreading on 30 DAS	11.7	16.7	18.2
T_6: Cowpea intercropping (1:1) *fb* spreading on 30 DAS	11.4	16.4	17.9
T_7: Coir pith mulching (5 tons ha^{-1}) on 3 DAS	9.3	12.9	14.9
T_8: Shredded coconut waste mulching (5 tons ha^{-1}) on 3 DAS	11.2	15.8	17.3
T_9: Mechanical weeding on 20 and 40 DAS	11.6	16.1	17.7
T_{10}: Hand weeding on 20 and 40 DAS	14.8	20.3	22.5
T_{11}: Mechanical weeding on 20 DAS *fb*hand weeding on 40 DAS	12.3	17.1	18.7
T_{12}: Weedy check	8.8	12.3	14.1
SEd	**0.7**	**1.0**	**1.1**
CD (P=0.05)	**1.6**	**2.1**	**2.3**

(PE – Pre emergent, EPOE – Early Post Emergence application, DAS – Days after sowing, *fb* – followed by)

Table 3.Influence of chemical and non-chemical weed management practices on productive tillers $m^{-2}$and per cent unproductive tillers of aerobic rice

Treatments	No. of productive tillers m^{-2}	Per cent unproductive tillers
T_1: PE pendimethalin (1 kg ha^{-1}) on 3 DAS *fb*hand weeding on 40 DAS	284.2	13.1
T_2: EPOE bispyribac sodium (25 g ha^{-1}) on 20 DAS *fb*hand weeding on 40 DAS	273.5	14.3
T_3: EPOE chlorimuron ethyl + metsulfuron methyl (4 g ha^{-1}) on 2-3 leaf stage of weeds	227.3	15.6
T_4: PE pendimethalin (1 kg ha^{-1}) on 3 DAS *fb*EPOE bispyribac sodium (25 g ha^{-1}) on 20 DAS	293.5	12.8
T_5: *Daincha* intercropping (1:1) *fb* spreading on 30 DAS	187.3	21.4
T_6: Cowpea intercropping (1:1) *fb* spreading on 30 DAS	172.5	22.1
T_7: Coir pith mulching (5 tons ha^{-1}) on 3 DAS	121.3	27.1
T_8: Shredded coconut waste mulching (5 tons ha^{-1}) on 3 DAS	149.3	24.7
T_9: Mechanical weeding on 20 and 40 DAS	162.1	22.6
T_{10}: Hand weeding on 20 and 40 DAS	297.3	12.8
T_{11}: Mechanical weeding on 20 DAS *fb*hand weeding on 40 DAS	243.5	14.6
T_{12}: Weedy check	112.3	29.9
SEd	**13.1**	-
CD (P=0.05)	**27.4**	-

(PE – Pre emergent, EPOE – Early Post Emergence application, DAS – Days after sowing, *fb* – followed by)

Table 4. Influence of chemical and non chemical weed management practices on number of grains panicle^{-1}, number of filled grains panicle^{-1} and grain filling per cent

Treatments	No. of grains panicle^{-1}	No. of filled grains panicle^{-1}	Grain filling (%)
T_1: PE pendimethalin (1 kg ha^{-1}) on 3 DAS *fb*hand weeding on 40 DAS	146.8	130.6	89.0
T_2: EPOE bispyribac sodium (25 g ha^{-1}) on 20 DAS *fb*hand weeding on 40 DAS	145.7	129.2	88.7
T_3: EPOE chlorimuron ethyl + metsulfuron methyl (4 g ha^{-1}) on 2-3 leaf stage of weeds	134.0	108.7	81.1
T_4: PE pendimethalin (1 kg ha^{-1}) on 3 DAS *fb*EPOE bispyribac sodium (25 g ha^{-1}) on 20 DAS	150.2	136.0	90.5
T_5: *Daincha* intercropping (1:1) *fb* spreading on 30 DAS	123.4	99.5	80.6
T_6: Cowpea intercropping (1:1) *fb* spreading on 30 DAS	122.6	99.3	81.0
T_7: Coir pith mulching (5 tons ha^{-1}) on 3 DAS	117.2	87.3	74.5
T_8: Shredded coconut waste mulching (5 tons ha^{-1}) on 3 DAS	121.8	93.7	76.9
T_9: Mechanical weeding on 20 and 40 DAS	127.1	95.9	75.5
T_{10}: Hand weeding on 20 and 40 DAS	151.7	137.5	90.6
T_{11}: Mechanical weeding on 20 DAS *fb*hand weeding on 40 DAS	135.3	113.6	84.0
T_{12}: Weedy check	111.3	82.2	73.9
SEd	**8.3**	**6.1**	**-**
CD (P=0.05)	**17.4**	**12.6**	**-**

(PE – Pre emergent, EPOE – Early Post Emergence application, DAS – Days after sowing, *fb* – followed by)

Table 5. Influence of chemical and non chemical weed management practices on panicle length, panicle weight and test weight of aerobic rice

Treatments	Panicle length (cm)	Panicle weight (g)	Test weight (g)
T_1: PE pendimethalin (1 kg ha^{-1}) on 3 DAS *fb*hand weeding on 40 DAS	22.8	2.5	20.4
T_2: EPOE bispyribac sodium (25 g ha^{-1}) on 20 DAS *fb*hand weeding on 40 DAS	22.7	2.3	20.5
T_3: EPOE chlorimuron ethyl + metsulfuron methyl (4 g ha^{-1}) on 2-3 leaf stage of weeds	21.9	1.9	20.2
T_4: PE pendimethalin (1 kg ha^{-1}) on 3 DAS *fb*EPOE bispyribac sodium (25 g ha^{-1}) on 20 DAS	23.1	2.8	20.8
T_5: *Daincha* intercropping (1:1) *fb* spreading on 30 DAS	21.2	1.8	20.2
T_6: Cowpea intercropping (1:1) *fb* spreading on 30 DAS	21.3	1.6	19.9
T_7: Coir pith mulching (5 tons ha^{-1}) on 3 DAS	19.9	1.1	18.9
T_8: Shredded coconut waste mulching (5 tons ha^{-1}) on 3 DAS	20.9	1.3	19.3
T_9: Mechanical weeding on 20 and 40 DAS	21.5	1.5	20.1
T_{10}: Hand weeding on 20 and 40 DAS	23.5	2.9	21.0
T_{11}: Mechanical weeding on 20 DAS *fb*hand weeding on 40 DAS	21.8	2.1	20.2
T_{12}: Weedy check	19.8	0.9	18.7
SEd	**1.2**	**0.15**	**0.93**
CD (P=0.05)	**NS**	**0.32**	**NS**

(PE – Pre emergent, EPOE – Early Post Emergence application, DAS – Days after sowing, *fb* – followed by)

Table 6.Influence of chemical and non-chemical weed management practices on grain and straw yield and harvest index of aerobic rice

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index
T_1: PE pendimethalin (1 kg ha^{-1}) on 3 DAS *fb*hand weeding on 40 DAS	4031	5512	0.42
T_2: EPOE bispyribac sodium (25 g ha^{-1}) on 20 DAS *fb*hand weeding on 40 DAS	3987	5389	0.43
T_3: EPOE chlorimuron ethyl + metsulfuron methyl (4 g ha^{-1}) on 2-3 leaf stage of weeds	3006	4589	0.40
T_4: PE pendimethalin (1 kg ha^{-1}) on 3 DAS *fb*EPOE bispyribac sodium (25 g ha^{-1}) on 20 DAS	4128	5697	0.42
T_5: *Daincha* intercropping (1:1) *fb* spreading on 30 DAS	2576	3940	0.40
T_6: Cowpea intercropping (1:1) *fb* spreading on 30 DAS	2426	3789	0.39
T_7: Coir pith mulching (5 tons ha^{-1}) on 3 DAS	1840	2840	0.39
T_8: Shredded coconut waste mulching (5 tons ha^{-1}) on 3 DAS	2212	3489	0.39
T_9: Mechanical weeding on 20 and 40 DAS	2321	3612	0.39
T_{10}: Hand weeding on 20 and 40 DAS	4298	5802	0.43
T_{11}: Mechanical weeding on 20 DAS *fb*hand weeding on 40 DAS	3286	4700	0.41
T_{12}: Weedy check	1670	2794	0.37
SEd	**179**	**310**	**-**
CD (P=0.05)	**371**	**643**	**-**

(PE – Pre emergent, EPOE – Early Post Emergence application, DAS – Days after sowing, *fb* – followed by)