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Yield losses due to dominant weed species in direct seeded rice (*Oryza sativa* L.) in Chhattisgarh plains

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Abstract

A field experiment was conducted at Raipur to study the yield losses due to dominant weed species in direct seeded rice (*Oryza sativa* L.). Five Major weed flora were allowed to grow: *Echinochloa colona*, *Cyperus iria*, *Alternanthera triandra*, *Spilanthes acmella*, *Cyanotis axilaris* and group of weed species including grassy weeds, broad leaved weeds, mixed flora (control). The result of the experiment indicated that maximum yield losses occurred due to mixed flora (control) and the minimum yield loss occurred in weed free treatment. Among the five major weed species weed density, weed dry weight at harvest were maximum in *Spilanthes acmella* which were followed by *Alternanthera triandra*, *Cyanotis axilaris* *Cyperus iria*, *Echinochloa colona*. The highest grain (4.49 t ha⁻¹) and straw yield (4.71 t ha⁻¹) of rice were observed in weed free treatment and the minimum grain (0.53 t ha⁻¹) and straw yield (0.93 t ha⁻¹) under mixed flora (control).

Keywords: *Oryza sativa* L., seeded rice, dominant weed

Introduction

Rice (*Oryza sativa* L.) is the most important and extensively grown crop in tropical and subtropical regions of the world as it is staple food for more than 60% of the world population. Rice occupies a prime position among food crops under diversified situation. About 90% of all rice grown in the world is produced and consumed in the Asian region. India is the second largest producer and consumer of rice in the world. Weeds compete for moisture, nutrients, light and space and a consequence, weeds infestation in direct seeded rice results in yield losses in the range of 30 to 90%, reduces grain quality and enhances the cost of production (Singh *et al.*, 2009) [8] Uncontrolled weeds cause up to 80% reduction in grain yield and sometime also results in complete failure of crop (Gopinath and Kundu, 2008) [3]. The main reasons for high weed pressure in direct seeded rice are the absence of a weed suppressive effect of standing water at the time of crop emergence and the absence of a seedling. Weeds in direct seeded rice systems are mainly managed by using herbicides and manual weeding. Major weeds found in Chhattisgarh plains are *Echinochloa colona*, *Echinochloa crus-galli*, *Ischaemum rugosum*, *Oryza sativa* (weedy rice), *Leptochloa chinensis*, *Paspalum distichum* among the grasses. *Cyperus iria*, *Cyperus difformis*, *Cyperus rotundus*, *Fimbristylis miliacea* among the sedges and *Monochoria vaginalis*, *Eclipta prostrate*, *Commelina benghalensis*, *Cynotis axillaris*, *Cesulia axillaris*, *Alternanthera triandra* among the broad leaved weeds.

Material and method

A field experiment was conducted at Research cum instructional farm Indira Gandhi Krishi vishwavidyalay Raipur with objective to find out the Yield losses due to dominant weed species in direct seeded rice (*Oryza sativa* L.) under medium land situation. The experimental field was sandy loam in texture, poor in organic carbon (0.45%), available nitrogen (205.4 kg ha⁻¹) and medium in available phosphorus (16.2kg ha⁻¹) and potash (321 kg ha⁻¹). The treatments consist of Infestation of *Echinochloa colona* (T₁), Infestation of *Cyperus iria* (T₂), Infestation of *Alternanthera triandra* (T₃), Infestation of *Spilanthes acmella* (T₄), Infestation of *Cyanotis axilaris* (T₅), Infestation of grasses (T₆), Infestation of broad leaved weeds (T₇), control (Mixed flora) (T₈) and weed free (3 Hand weeding) (T₉). The experiment was laid out in a randomized block design with three replications. The crop was sown on 27.06.16 and harvested on 03.11.16.

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The rice variety "Rajeshwari" with a seed rate of 40 kg ha⁻¹ was used for sowing and fertilized with NPK @ 100: 50: 30 kg ha⁻¹. Half of nitrogen and full dose of phosphorus and potash was applied at the time of sowing. The rest half of nitrogen was applied at 25 and 50 days after sowing. The crop was sown in rows at 20 centimeters apart under sufficient moisture condition. From sowing to emergence the soil was kept near moist but not saturated to avoid seed rotting. The field was saturated from three leaf stage to tillering, panicle initiation and grain filling stages to avoid water stress at these stages. However, at anthesis the excess water was drained out to avoid sterility. Weed management was done by only manual hand weeding at 20, 40 and 60 DAS to check the flush of undesirable weeds and to maintain the desirable weed population into the respective plots.

The observations on weed and crop was recorded at 20, 40, 60, 80 and at harvest from three randomly selected places in each plot. Species-wise and total weed count was made in randomly selected three quadrates of 50 cm x 50 cm (0.25 m²) from each plot. Weeds present in quadrate (0.25 m²) were uprooted carefully along with roots. The root portion was detached and shoot portion of the weed plants were oven dried at 60°C for 36 to 48 hours. After complete oven drying, species wise and total dry matter production of weeds was recorded for different treatments and converted to m⁻². Weeds density and weed dry weight data was subjected to square root of transformation i.e. $x + 0.5$ for statistical analysis.

Weed index

Weed index was calculated by the formula mentioned under. It is expressed in percentage.

$$WI = \frac{\text{Grain yield in hand weeded plot} - \text{Grain yield in treated plot}}{\text{Seed yield in treated plot}} \times 100$$

Result and discussion

Weed observation

Weed density

The data on weed density at different interval of time are presented in Table 1.

Infestation of *Echinochloa colona*: Weed density m⁻² observed at 20, 40, 60, 80 DAS and at harvest was 57.03, 109.97, 158.57, 101.47 and 32.2, respectively. The data revealed that weed density of *Echinochloa colona* increased up to 60 DAS after that it started to decline. Hence the maximum density m⁻² recorded at 60 DAS while the minimum density m⁻² was recorded at harvest. Kolhe and Tripathi (1998) [5] also reported that weed flora of DSR were *Echinochloa colona*, *Ischaemum rugosum*, *Cyperus iria* and *C. difformis*.

Infestation of *Cyperus iria*: The weed density m⁻² at 20, 40, 60, 80 DAS and at harvest was 22.87, 60.77, 106.03, 124.53 and 48.43, respectively. Data shows that density increased up to 80 DAS, after that, sharp reduction in weed density was observed. Hence the maximum density m⁻² recorded was 124.53 at 80 DAS while the minimum weed density m⁻² recorded was 48.43 at harvest.

Infestation of *Alternanthera triandra*: The weed density m⁻² at 20, 40, 60, 80 DAS and at harvest was 24.97, 68.13, 85.9, 92.4 and 96.13, respectively. It was observed that the density m⁻² increased up to the harvest of the crop. However, the maximum density m⁻² recorded was 96.13 at harvest and the minimum density observed was 24.97 at 20 DAS.

Infestation of *Spilanthes acmella*: The weed density m⁻² recorded at 20, 40, 60, 80 DAS and at harvest was 45.13, 114.00, 167.47, 198.16 and 217.70, respectively. Its density

m⁻² also followed the same trend as the *Alternanthera triandra*. Hence the maximum weed density observed at harvest was 217.70. And the minimum weed density m⁻² recorded at 20 DAS was 45.13.

Infestation of *Cyanotis axillaris*: The weed density recorded at 20, 40, 60, 80 DAS and at harvest was 36.70, 76.37, 86.50, 93.44 and 96.93, respectively. Its density m⁻² also followed the same trend as the *Spilanthes acmella*. However the maximum density per m² recorded at harvest was 96.63. And the minimum density m⁻² observed was 36.70 at 20 DAS.

Grassy weeds: The density of grasses m⁻² recorded at different interval of time was 76.77, 154.90, 220.47, 190.17 and 68.30 respectively. It was observed that the density of grassy weeds increased up to 60 DAS. After that it reduced. Hence the maximum density per m² recorded was 220.47 at 60 DAS. And the minimum density m⁻² recorded was 68.30 at harvest.

Broad leaved weeds: The weed density per m² was the density of all broad leaved weeds present in that plot. The weed density m⁻² at different interval of time was 55.20, 142.60, 180.40, 220.67 and 250.57, respectively. The maximum weed density m⁻² recorded was 250.57 at harvest. However, the minimum weed density m⁻² recorded were 55.20 at 20 DAS.

Control (Mixed flora): The weed density m⁻² was the density of all weeds present in that particular plot. The weed density m⁻² at 20, 40, 60, 80 DAS and at harvest was 88.70, 192.70, 250.23, 236.57 and 301.00, respectively.

The data revealed that weed density increased up to harvest hence, the maximum density m⁻² recorded was 301.00 at harvest. And the minimum density m⁻² recorded was 88.70 at 20 DAS.

Weed free (3 Hand weeding): Up to 20 DAS. There was maximum density m⁻² recorded 69.20 weeds. But at 40 DAS some weed population was recorded. Weed density recorded at 60, 80 DAS and at harvest was 11.30, 15.70, and 20.78, respectively.

Weed dry matter accumulation (g m⁻²)

The data on total dry matter accumulation at different interval of time are presented in Table 2 reveals that dry matter accumulation vary from species to species significantly. In general, the increased density of weeds enhanced dry matter accumulation of weeds per unit area.

Infestation of *Echinochloa colona*: The weed dry matter accumulation at 20, 40, 60, 80 DAS and at harvest was 20.50, 89.20, 184.90, 207.62 and 72.76 g m⁻², respectively. The data shows that the dry matter of *Echinochloa colona* increased up to 60 DAS. And after that it declined. Therefore the maximum dry matter recorded was 207.62 g m⁻² at 60 DAS. And the minimum dry matter recorded was 20.50 g m⁻² at 20 DAS.

Infestation of *Cyperus iria*: The dry matter at 20, 40, 60, 80 DAS and at harvest was 1.08, 28.60, 104.72, 115.63 and 55.38 g m⁻², respectively. The data reveals that the dry matter of *Cyperus iria* was initially very less. But, at 40-60 DAS it increased very rapidly. Again at harvest the dry matter reduced. Hence, the maximum dry matter recorded was 115.36 g m⁻² at 80 DAS. And the minimum dry matter recorded was 1.08 g m⁻² at 20 DAS.

Infestation of *Alternanthera triandra*: The dry matter accumulation in *Alternanthera triandra* at 20, 40, 60, 80 DAS and at harvest was 12.75, 84.14, 197.82, 280.18 and 300.54 g m⁻², respectively. The data shows that the dry matter of *Alternanthera triandra* increased up to the harvest of the crop. It was also observed that the dry matter of *Alternanthera triandra* was very less at 20 DAS. But, after that the dry

matter increased very rapidly, because of the woody nature of the stem of the weed. Therefore, the maximum dry matter recorded was 300.54 g m⁻² at harvest. And the minimum dry matter recorded was 12.75 g m⁻² at 20 DAS.

Infestation of *Spilanthes acmella*: The dry matter of *Spilanthes acmella* at 20, 40, 60, 80 DAS and at harvest was 5.70, 71.26, 165.88, 225.78 and 274.20 g m⁻², respectively. The data shows that initially at 20 DAS, the dry matter accumulation in *Spilanthes acmella* was very less. But, from 40 DAS to at harvest, it increased very rapidly, because of the bushy nature of the weed plant. Hence, the maximum dry matter recorded was 274.20 g m⁻² at harvest. However, the minimum dry matter recorded was 5.70 g m⁻² at 20 DAS.

Infestation of *Cyanotis axillaris*: The dry matter accumulation in *Cyanotis axillaris* at 20, 40, 60, 80 DAS and at harvest was 6.38, 60.64, 155.32, 215.35 and 240.00 g m⁻², respectively. The data shows that the dry matter of *Cyanotis axillaris* increased up to the harvest of the crop. And it was observed that its dry matter accumulation was comparatively lower than the dry matter of *Alternanthera triandra*, because of the succulent nature of the plant. Hence the maximum dry matter recorded was 240.00 g m⁻² at harvest. And the minimum dry matter recorded was 6.38 g m⁻² at 20 DAS.

Grassy weeds: The dry matter of grasses represents the dry matter of all grassy weeds present in that particular plot. The dry matter of grasses at 20, 40, 60, 80 DAS and at harvest was 32.24, 105.46, 245.27, 217.84 and 150.36 g m⁻², respectively. The data shows that the dry matter of grasses increased up to 60 DAS, after that it decreased. Hence the maximum dry matter recorded was 245.27 g m⁻² at 60 DAS. And the minimum dry matter recorded was 32.24 g m⁻² at 20 DAS. Singh *et al.* (2007) reported that in terms of weight grassy weed constituted 78-96% of total weed weight in all systems of rice establishment.

Broad leaved weeds: The dry matter of broad leaved weeds represents the dry matter of all broad leaved weeds present in that plot. The dry matter at 20, 40, 60, 80 DAS and at harvest was 22.68, 99.59, 177.76, 268.37 and 348.30 g m⁻², respectively. The data shows that the dry matter of broad leaved weeds increased till the harvest of the crop. Therefore the maximum dry matter recorded was 348.30 g m⁻² at harvest. And the minimum dry matter recorded was 22.68 g m⁻² at 20 DAS.

Control (Mixed flora): The dry matter of control (Mixed flora) plot represents the dry matter of all weed species present in that plot. The dry matter at 20, 40, 60, 80 DAS and at harvest was 35.44, 119.98, 285.23, 347.50 and 415.32 g m⁻², respectively. The data shows that the dry matter of control (Mixed flora) increased up to harvest. Hence the maximum dry matter recorded was 415.32 g m⁻² at harvest. And the minimum dry matter recorded was 35.44 g m⁻² at 20 DAS.

Weed free (3 Hand weeding): The dry matter at 20, 40, 60, 80 DAS and at harvest was 32.16, 7.18, 6.89, 10.13 and 23.39.

Yield and yield attributes

Grain yield

Among different treatments, the treatment of weed free (3 Hand weeding) (T₉) proved to be significantly superior over the other treatments in producing higher seed yield. However, the treatment of *Cyperus iria* (T₂) was next, in order and performed significantly better than the treatment of control (Mixed flora) (T₈). Mamun *et al.* (2013) [6] also reported that grain yield losses due to interference increased with weed population density increase. Patel *et al.* (1998) [7] at Raigarh

(C.G.) observed that when the weeds were allowed to grow with the crop, grain yield was reduced by about 48.6%.

The data shows that the minimum seed yield was obtained from the treatment of control (Mixed flora) (T₈) with a yield loss of about 88.04% followed by the treatment of grasses (T₆) where, seed yield recorded was 1.01 t ha⁻¹ and caused the yield loss of about 77.31%. The treatment of broad leaved weeds (T₇) was next to it with a seed yield of 1.1 t ha⁻¹ and caused the yield loss of about 75.25%. Followed by the treatment of *Echinochloa colona* (T₁) where seed yield recorded was 1.78 t ha⁻¹ and it causes the yield loss of about 59.71%, *Alternanthera triandra* (T₄) where, seed yield recorded was 1.92 t ha⁻¹ and it caused the yield loss of about 56.82%. Next to it, there was the treatment of *Cyanotis axillaris* (T₅), where, seed yield recorded was 2.17 t ha⁻¹ and caused the yield loss of about 51.37%. The treatment of *Spilanthes acmella* (T₄) was next to it. Where, the seed yield recorded was 2.42 t ha⁻¹ and caused the yield loss of about 45.79%. Sinha *et al.* (1992) [9] also reported that unchecked weed compete with rice plants for light, nutrients and moisture resulting reduction of grain yield up to 80%. Azmi and Baki (1995) [2] also reported that Yield loss caused by grasses and broad leaved weeds was 41 and 28%, respectively and grain weight and grain yield of rice in dry sown showed highly negative correlation with growth of *Echinochloa* species. Abdullah *et al.*, (2014) [1] reported that the rice plants produced the highest grain yield m⁻² when grown in the absences of weeds. Kapoor and Ramkrishna (1975) [4] reported that *Echinochloa colona* causes substantial yield reductions because of its severe infestations, rapid growth and great competitive ability.

Straw yield

The data on straw yield are given in Table 4. Data shows that the straw yield significantly affected by the various dominant weed species.

Among various treatments the treatment of weed free (3 Hand weeding) (T₉) proved significantly superior over the other treatments in producing higher straw yield. However, the treatment of *Cyperus iria* (T₂) also proved significantly better than the treatment of control (Mixed flora) (T₈). The minimum straw yield was recorded under the treatment of control (Mixed flora) (T₈), due to the more dry matter of weed and its density, or due to the higher crop weed competition which does not allow crop to grow with their genetic potential. Straw yield from other treatments was in the increasing order of the treatment of grasses (T₆) from where the second lowest straw yield was recorded, followed by the treatments of broad leaved weeds (T₇), *Echinochloa colona* (T₁), *Alternanthera triandra* (T₃), *Cyanotis axillaris* (T₅) and *Spilanthes acmella* (T₄), respectively.

Harvest index

Harvest index data revealed that different weed species significantly influenced the harvest index values. Significantly highest harvest index value over other was recorded under the treatment of weed free (3 Hand weeding) (T₉). However, the second highest value of harvest index was recorded under the treatment of *Cyperus iria* (T₂) followed by the treatment of *Spilanthes acmella* (T₄) Whereas, the lowest harvest index was recorded under the treatment of control (Mixed flora) (T₈), followed by the treatment of grasses (T₆), broad leaved weeds (T₇). While the harvest index value of treatments of *Cyanotis axillaris* (T₅), *Alternanthera triandra* (T₃), *Echinochloa colona* (T₁) was quite better than the harvest index value of control (Mixed flora) (T₈).

Table 1: Dry matter accumulation in various dominant weed species at different intervals in Direct seeded rice, *kharif* 2016.

| Treatments | Weed dry matter g m ⁻² | | | | |
|---|-----------------------------------|----------------|----------------|----------------|----------------|
| | 20 DAS | 40 DAS | 60 DAS | 80 DAS | At Harvest |
| T ₁ Infestation of <i>Echinochloa colona</i> | 4.58 (20.50) | 9.47 (89.20) | 14.43 (184.90) | 13.62 (207.62) | 8.56 (72.76) |
| T ₂ Infestation of <i>Cyperus iria</i> | 1.26 (1.08) | 5.39 (28.60) | 10.26 (104.72) | 10.78 (115.63) | 7.48 (55.38) |
| T ₃ Infestation of <i>Alternanthera triandra</i> | 3.64 (12.75) | 9.20 (84.14) | 14.08 (197.92) | 16.75 (280.18) | 17.35 (300.54) |
| T ₄ Infestation of <i>Spilanthes acmella</i> | 2.49 (5.70) | 8.47 (71.26) | 12.90 (165.88) | 15.04 (225.78) | 16.57 (274.20) |
| T ₅ Infestation of <i>Cynotis axillaris</i> | 2.62 (6.38) | 7.82 (60.64) | 12.48 (155.32) | 14.69 (215.35) | 15.51 (240.00) |
| T ₆ Infestation of grasses | 5.54 (30.24) | 10.29 (105.46) | 15.68 (245.27) | 14.78 (217.84) | 12.28 (150.36) |
| T ₇ Infestation of broad leaved weeds | 4.81 (22.68) | 10.00 (99.59) | 13.35 (177.76) | 16.40 (268.37) | 18.68 (348.30) |
| T ₈ Control (Mixed flora) | 5.99 (35.44) | 10.98 (119.98) | 16.90 (285.23) | 18.65 (347.50) | 20.39 (415.32) |
| T ₉ Weed free (3 Hand weeding) | 5.71 (32.16) | 2.77 (7.18) | 2.72 (6.89) | 3.26 (10.13) | 4.89 (23.39) |
| Sem± | 0.12 | 0.13 | 0.76 | 0.92 | 0.76 |
| CD 5% | 0.38 | 1.01 | 2.28 | 2.77 | 2.30 |

Figures in the parentheses are original value, data were transformed through $\sqrt{x+0.5}$ which are given in bold

Table 2: Weed densities of various dominant weed species at different intervals in Direct seeded rice *kharif* 2016.

| Treatments | Weed density (m ⁻²) | | | | |
|---|---------------------------------|----------------|----------------|----------------|----------------|
| | 20 DAS | 40 DAS | 60 DAS | 80 DAS | At Harvest |
| T ₁ Infestation of <i>Echinochloa colona</i> | 7.58 (57.03) | 10.51 (109.97) | 12.61 (158.57) | 10.10 (101.47) | 5.72 (32.2) |
| T ₂ Infestation of <i>Cyperus iria</i> | 4.83 (22.87) | 7.83 (60.77) | 10.32 (106.03) | 11.18 (124.53) | 6.99 (48.43) |
| T ₃ Infestation of <i>Alternanthera triandra</i> | 5.05 (24.97) | 8.28 (68.13) | 9.29 (85.9) | 9.64 (92.4) | 9.83 (96.13) |
| T ₄ Infestation of <i>Spilanthes acmella</i> | 6.27 (45.13) | 10.70 (114.00) | 12.96 (167.47) | 14.09 (198.16) | 14.77 (217.70) |
| T ₅ Infestation of <i>Cynotis axillaris</i> | 6.10 (36.70) | 8.77 (76.37) | 9.33 (86.50) | 9.69 (93.44) | 9.87 (96.93) |
| T ₆ Infestation of grasses | 8.79 (76.77) | 12.47 (154.90) | 14.86 (220.47) | 13.81 (190.17) | 8.29 (68.30) |
| T ₇ Infestation of broad leaved weeds | 7.46 (55.20) | 11.96 (142.60) | 13.45 (180.40) | 14.87 (220.67) | 15.85 (220.67) |
| T ₈ Control (Mixed flora) | 9.44 (88.70) | 13.90 (192.70) | 15.83 (250.23) | 15.40 (236.57) | 17.36 (301.00) |
| T ₉ Weed free (3 Hand weeding) | 8.35 (69.20) | 3.47 (12.43) | 3.43 (11.30) | 4.02 (15.70) | 4.57 (20.78) |
| Sem± | 0.42 | 0.73 | 0.94 | 1.008 | 0.39 |
| CD 5% | 1.27 | 2.20 | 2.82 | 3.02 | 1.18 |

Figures in the parentheses are original value, data were transformed through $\sqrt{x+0.5}$ which are given in bold

Table 3: Weed Index (%) as affected by various dominant weed species in Direct seeded rice, *kharif* 2016.

| Treatments | Weed index (%) |
|---|----------------|
| T ₁ Infestation of <i>Echinochloa colona</i> | 59.71 |
| T ₂ Infestation of <i>Cyperus iria</i> | 31.85 |
| T ₃ Infestation of <i>Alternanthera triandra</i> | 56.82 |
| T ₄ Infestation of <i>Spilanthes acmella</i> | 45.79 |
| T ₅ Infestation of <i>Cyanotis axillaris</i> | 51.37 |
| T ₆ Infestation of grasses | 77.31 |
| T ₇ Infestation of broad leaf weed | 75.25 |
| T ₈ Control (Mixed flora) | 88.04 |

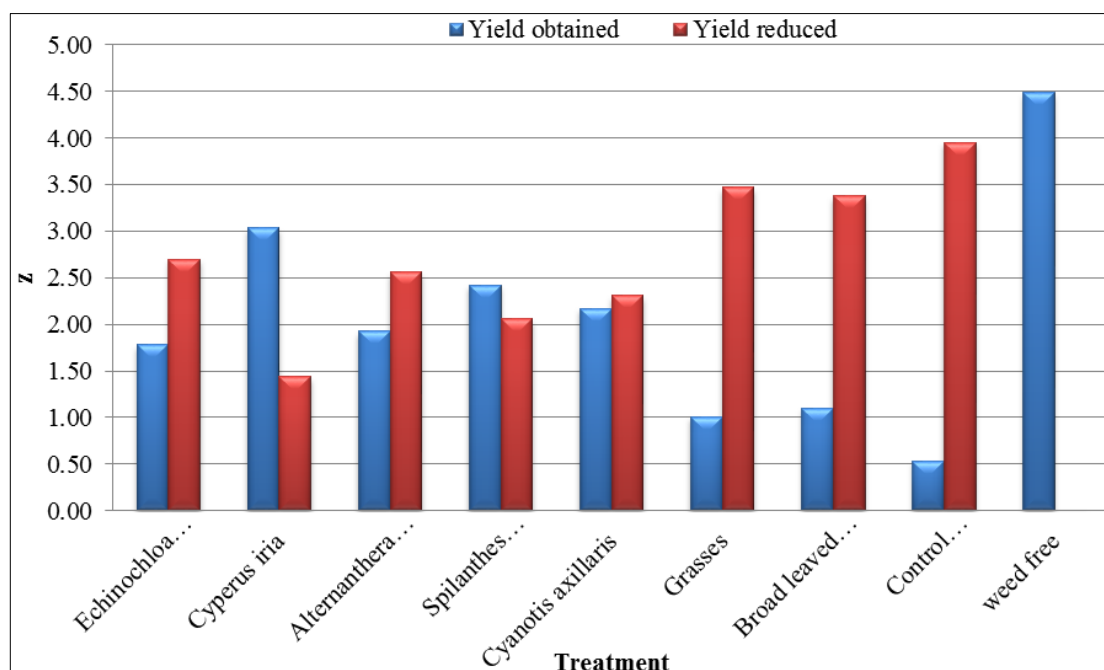
**Fig 1:** Yield obtained and reduced due to various dominant weeds in Direct seeded rice

Table 4: Seed yield t ha⁻¹, straw yield t ha⁻¹, harvest index % as affected by the various dominant weed species in Direct seeded rice *kharif* 2016.

| Treatments | | Seed yield (t ha ⁻¹) | Straw yield (t ha ⁻¹) | Harvest index % |
|----------------|--|----------------------------------|-----------------------------------|-----------------|
| T ₁ | Infestation of <i>Echinochloa colona</i> | 1.78 | 2.11 | 37.84 |
| T ₂ | Infestation of <i>Cyperus iria</i> | 3.04 | 3.46 | 41.87 |
| T ₃ | Infestation of <i>Alternanthera triandra</i> | 1.92 | 2.43 | 37.74 |
| T ₄ | Infestation of <i>Spilanthus acmella</i> | 2.42 | 2.68 | 41.45 |
| T ₅ | Infestation of <i>Cyanotis axillaris</i> | 2.17 | 2.57 | 39.55 |
| T ₆ | Infestation of grasses | 1.01 | 1.34 | 33.00 |
| T ₇ | Infestation of broad leaf weeds | 1.10 | 1.49 | 33.44 |
| T ₈ | Control (Mixed flora) | 0.53 | 0.93 | 24.07 |
| T ₉ | Weed free(3 Hand weeding) | 4.49 | 4.71 | 45.63 |
| | SEm± | 0.12 | 0.16 | 0.59 |
| | CD 5% | 0.38 | 0.48 | 1.77 |

Conclusion

Growth requirements of crop and weeds are identical. Therefore when weeds are allowed to grow with crop plants for all the growth factors. Unfortunately weeds absorb nutrients and moisture faster and smother than crop plants leading to reduced yields. Studies on yield losses in direct seeded rice due to various dominant weed species reveals that maximum yield loss of about 88.04% recorded under control (Mixed flora) This was followed by grasses 77.31 %, by broad leaved weeds 75.25 %, by infestation of *Echinochloa colona* 59.71%, by infestation of *Alternanthera triandra* 56.82 %, by infestation of *Cyanotis axillaris*, 51.37 %, by infestation of *Spilanthus acmella*, 45.79% by and by infestation of *Cyperus iria* 31.85%.

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