Chapter IV

EXPERIMENTAL RESULTS

The important findings obtained during the course of investigation on weed management in maize based intercropping system and the statistical interpretation relating to growth, yield attributes, yield, weed density, weed dry matter, nutrient (NPK) uptake, crop competition and economics have been presented in this chapter.

4.1 STUDIES ON CROPS

4.1.1 Growth and Yield attributes of component crops

4.1.1.1 Maize

4.1.1.1.1 Plant population

Mean data on plant population of maize as influenced by cropping system and weed management practices have been given in table 4.1.

Analysed data revealed that the plant population of maize were not significantly influenced by different cropping system and weed control treatments.

4.1.1.2 Plant height

Data on plant height of maize at different stages of growth as influenced by cropping system and weed management have been presented in table 4.2.

Analysed data (Pooled) revealed that the plant height of maize was significantly influenced by intercropping system at 30 and 60 days after sowing. However, at 60 days in 2004 and 2005, the plant height of maize was not significantly influenced by the cropping system. At harvest, plant height of maize was not significantly affected by cropping system.
At 30 and 60 days of sowing, maximum plant height of maize (48.75 cm) and (81.06 cm) was recorded from the sole cropping of maize and was statistically at par with the height of maize (46.59 cm and 78.84 cm) when intercropping with soybean in their respective growth stages.

The recorded plant height of maize under sole as well as intercropping with soybean was significantly higher than the height of maize recorded from maize + groundnut intercropping system at 30 and 60 days after sowing (42.75 cm and 74.67 cm, respectively).

At harvest, cropping system did not produce any significant difference in plant height of maize.

The effect of weed management practices on plant height of maize at 30, 60 days after sowing and also at harvest, was found to be statistically significant.

The tallest plants of maize (55.38, 92.14, 159.00 cm) were recorded from the plots receiving three weeding at 15, 30 and 45 days of sowing at all the three stages of crop growth i.e. 30, 60 days after sowing and at harvest which in turn were statistically at par with the plant height of maize recorded from the plots which were sprayed with the per-emergence application of oxyfluorfen @ 0.2 kg a.i.ha⁻¹, and was significantly superior to the height of maize recorded under rest of weed control treatments. At harvest performance of pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha⁻¹ and Alachlor @ 2.0 kg a.i.ha⁻¹ was found statistically alike in obtaining plant height of maize. Significantly smallest plants of maize were observed under weedy check plots at the respective stages of crop growth.

4.1.1.1.3 Number of cobs per plant

The mean data on number of cobs per plant of maize as influenced by cropping system and weed management treatments has been given in table 4.3.
Pooled data of two years experimentation indicated that the effect of cropping system on number of cobs per plant was statistically non-significant whereas the effect due to weed control treatments on mean number of maize cob per plant was found to be significant.

Cropping system failed to bring any significant variations in mean number of cobs per plant of maize.

Weed management treatments significantly influenced the number of cobs per plant of maize. Weeding thrice (at 15, 30 and 45 days after sowing) produced significantly higher number of maize cobs (1.47) per plant and was statistically at par with the mean number of maize cobs per plant obtained from the plots having treated with pre-emergence application of oxyfluorfen @ 0.20 kg a.i.ha⁻¹ (1.40) and alachlor @ 2.0 kg a.i.ha⁻¹. Significantly lowest number of cobs pr plant of maize was obtained from the plots where no weed management practices were followed and kept it as weedy check control.

4.1.1.1.4 Cob length

The mean data (pooled) on cob length (cm) of maize as affected by cropping system and weed management practices have been mentioned in table 4.3.

The analyzed (pooled) data relating to cob length of maize revealed that the effect due to cropping system on cob length of maize was non-significant where as the weed control treatments significantly influenced the cob length of maize.

Different cropping system had no significant influence on cob length of maize. However slightly longer maize cob (16.04 and 15.79 cm) was obtained under sole cropping of maize and maize + soybean intercropping system.

Weed management practices significantly increased the cob length of maize compared to weedy check. Significantly longer cobs of maize (16.88 cm) was recorded from the plots where the weed density was kept minimum by
weeding thrice (at 15, 30 and 45 days after sowing) and was statistically alike with the cob length of maize obtained under pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) (16.26 cm), which inturn were significantly superior to the maize cob length obtained under rest of the weed control treatments.

4.1.1.1.5 Cob diameter

Data on cob diameter of maize as influenced by cropping system and weed management treatments presented in table 4.3 revealed that the cropping system did not had any significant influence on cob diameter, whereas weed management practices significantly influenced the cob diameter of maize.

Among the different weed management practices, adoption of weeding thrice (15, 30 and 45 days after sowing) helped in producing the bold cob of maize (15.35 cm) and it was statistically at par with the value of cob diameter of maize recorded from the plots treated with pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) (14.73 cm) and alachlor @ 2.0 kg a.i.ha\(^{-1}\) (14.62 cm) and inturn were superior to the rest of the weed control treatments under test. All the chemical weed control methods of weeds management also proved significantly superior to weedy check.

4.1.1.1.6 Number of grain row per cob

Analysis of pooled data on number of grain rows per cobs of maize given in table 4.3 clearly indicated that there was non-significant variations in mean number of grain rows per cob of maize due to different cropping system. Whereas different methods of weed management practices produced significant variations in number of grain rows per cob of maize.

Weed management practices differed significantly among themselves and significantly higher number of grain rows in cob (17.27) was obtained from the maize plants of the plots weeding thrice (15, 30 and 45 days after
sowing) being at par with the mean number of grain rows per cob of maize from the plots sprayed with pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha⁻¹. It has been further observed that all the weed management practices performed better over weedy check.

4.1.1.1.7 Number of grains per row

Data on mean number of grains per row of maize cob as presented in table 4.3 revealed that the influence of cropping system was statistically non-significant. But different weed management practices significantly influenced the mean number of grain per row of maize cob.

Sole cropping of maize recorded more number of grain per row of maize cobs (26.99) than that of grain number obtained from the maize cobs grown with maize + soybean (26.76) and maize + groundnut (26.28) intercropping system.

Number of grains per row of maize cob was significantly influenced by different weed management practices. Weeding thrice (15, 30 and 45 days after sowing) produced maximum number of grains per row of maize cob (28.54) being at par with the value obtained under pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha⁻¹ and inturn was significantly superior to the rest of the weed control treatments. All the chemical weed control treatments were found to be effective in producing more number of grains over weedy check.

4.1.1.1.8 100-grain weight

The mean data on 100-grain weight as influenced by cropping system and different weed management treatments presented in table 4.3 clearly indicated that the effect of cropping system on 100-grain weight of maize was found to be non significant. However, highest 100-grain weight (34.42g) was recorded in sole cropping of maize followed by maize + soybean (34.12g) and maize + groundnut (34.00g) intercropping system.
100-grain weight of maize was significantly influenced by weed management treatments. The highest 100-grain weight 35.67 g was recorded under three weeding done at 15, 30 and 45 days after sowing and was statistically at par with value of 100-grain weight of maize obtained from the plots having treated with pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) (35.25 g) and alachlor @ 2.0 kg a.i.ha\(^{-1}\) (34.45 g) and inturn were significantly superior to the rest of the weed management treatments. All the chemical methods of weed management showed their superiority over weedy check.

**4.1.1.2 Soybean**

4.1.1.2.1 Plant population

Mean data on plant population of soybean as influenced by cropping system and weed management practices have been presented in table 4.4.

Analysed data revealed that the plant population of soybean were not significantly influenced by different cropping system and weed management practices.

4.1.1.2.2 Plant height

Mean data on plant height of soybean as influenced by cropping system and weed management practices have been given in table 4.5.

Pooled data of both year experimentation indicated that the effect of cropping system on plant height at 60 days after sowing and at harvest was statistically non-significant means was unable to produce significant difference in plant height of soybean, whereas at 30 days after sowing the plant height was significantly influenced by cropping system. It was also observed that the height of soybean at 30 days after sowing was not significantly influenced by cropping system in the year 2004 and 2005.

Pooled data revealed that at 30 days after sowing maximum plant height (35.27 cm) was recorded when soybean was intercropped with maize.
and was significantly superior to the plant height (30.58 cm) recorded under sole cropping of soybean.

Pooled data of both years experimentation revealed that all the weed management practices significantly influenced the plant height of soybean at different stages of crop growth (30, 60 days after sowing and at harvest). Significantly taller plants of 39.35, 76.75 and 84.00 cm were recorded from the plots receiving three weeding (15, 30 and 45 days after sowing) at their respective growth stages. At 30 and 60 days after sowing the performance of three weeding manually at 15, 30 and 45 days after sowing and pre-emergence application of oxyfluorfen @ 0.2 kg a.i. ha\(^{-1}\) was similar in producing the plant height of soybean was statistically comparable and in turn were significantly superior to the rest of the chemical weed control methods.

All the weed control methods were significantly superior in respect of plant height of soybean to the weedy check registering the smallest plant of soybean at all the stages of crop growth.

4.1.1.2.3 Number of nodules per plant

Pooled data on number of nodules per plant in soybean at different stages of crop growth influenced by cropping system and weed management practices have been presented in table 4.6.

Cropping system did not produce any significant variation in number of nodules per plant of soybean at all the three stages of crop growth (30, 60 and 90 days after sowing). It was observed that number of nodules increased up to 60 days of sowing and thereafter decreased. It was further observed that the soybean plant bears slightly more number of nodules when grown with maize as compared to sole cropping at all the respective growth stages.

Weed management treatments had significant effect on number of nodules per plant of soybean at all the stages of crop growth (30, 60 and 90 days after sowing).
All the weed management practices were found significantly superior to produce more number of nodules in soybean plant to weedy check at all the respective stages of crop growth. Plants of the plots receiving three weeding (15, 30 and 45 days after sowing) produced highest numbers of nodules (28.96, 54.59 and 32.91) at all the stages of crop growth (30, 60 and 90 days after sowing) and was statistically comparable with the number of nodules per plant of the plots having treated with pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) except 60 days of sowing where weeding thrice performed significantly to the rest of the treatments. At 30 and 90 days after sowing performance of pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) being at par with weeding thrice were significantly superior to the rest of the weed control treatments.

However, different weed control treatments showed their superiority in producing more number of nodules per plant over weedy check, which recorded significantly lowest number of nodules per plant (15.37, 29.86 and 15.81) in the respective stages of crop growth.

4.1.1.2.4 Number of branches per plant

Data on number of branches per plant of soybean as influenced by cropping system and weed management treatments have been presented in table 4.7.

The effect of cropping system on number of branches per plant in soybean was found non-significant. However, more number of branches per plant (6.77) were recorded from the soybean plant when intercropped with maize.

Number of branches per plant of soybean were significantly influenced by different weed management treatments. Plots receiving weeding thrice at 15, 30 and 45 days of sowing produced highest number of branches per plant of soybean (8.07) and was statistically at par with value of branches recorded
from the soybean plants from the plots which were treated with pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) and alachlor @ 2.0 kg a.i.ha\(^{-1}\) which in turn were significantly superior to the rest of the weed control treatments. All the weed management practices proved their superiority in producing more number of branches in soybean plant to the weedy check. It was further observed that the herbicides oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) and alachlor @ 2.0 kg a.i.ha\(^{-1}\), as pre-emergence application were comparable with manual weeding thrice at 15, 30 and 45 days of sowing in this regard.

4.1.1.2.5 Number of pods per plant

Analysed data (pooled) of number of pods per plant in soybean as given in table 4.7 indicated that the influence of cropping system on number of pods per plant of soybean was non significant.

The effect of weed management treatments on number of pods per plant of soybean was found significant. Plots receiving three weeding at 15, 30 and 45 days after sowing produced highest number of pods per plant of soybean (44.50) which was comparable with that of per-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) (42.50) and was significantly superior to the number of pods per plant obtained from rest of the weed management treatments. All the chemical methods of weed control including hand weeding proved their superiority in producing higher number of pods per plant of soybean to weedy check.

4.1.1.2.6 Number of seeds per pod

The effect due to cropping system on number of seeds per pod of soybean as given in table 4.7 was found to be statistically non-significant. Whereas the different weed management practices produced significant variation in number of seeds per pod of soybean.
Although more number of seeds per pod was recorded from the soybean plant when intercropped with maize but the difference among the treatments was statistically non-significant.

Weed management practices produced significant variation in number of seeds per pod of soybean. Among weed control treatments, weeding thrice at 15, 30 and 45 days after sowing produced maximum number of seeds per pod of soybean (3.07) and was at par with value recorded from the plots where oxyfluorfen @ 0.2 kg a.i.ha⁻¹ was applied as pre-emergence application (2.97) and in turn was significantly superior to the rest of the weed control treatments. Next best herbicide in this regard is alachlor when applied @ 2.0 kg a.i.ha⁻¹ as pre-emergence application. Significantly lowest number of seeds per pod of soybean (2.52) was recorded under weedy check.

4.1.1.2.7 100 gain weight

Analysed mean data (pooled) on 100-grain weight of soybean as influenced by cropping systems and weed management practices have been presented in table 4.7.

Pooled data revealed that the influence of cropping system on 100-grain weight of soybean was statistically non-significant indicating that the different cropping systems did not produce any significant difference in 100-grain weight of soybean.

Different weed control treatments significantly influenced the 100-grain weight of soybean. The highest 100-grain weight was recorded under the plots which received three manual weeding at 15, 30 and 45 days after sowing and was statistically comparable with the 100-grain weight obtained under the weed control treatment of pre-emergence application of oxyfluorfen @ 0.2 a.i.ha⁻¹ (14.47g) and these in turn were significantly superior to the rest of the weed control treatments. However, the 100-grain weight recorded under the weed control treatment of pre-emergence application of alachlor @ 2.0 kg
a.i. ha\(^{-1}\) (13.50g) and the combined application of butachlor @ 1.5 kg a.i. ha\(^{-1}\) as pre-emergence + quizalofop-ethyl @ 100 ml ha\(^{-1}\) as post-emergence (13.49g) were statistically at par with each other. All the weed control treatments i.e., chemical as well as manual weeding proved their superiority over weedy check (12.46g).

**4.1.1.3 Groundnut**

**4.1.1.3.1 Plant Population**

Mean data on plant population of groundnut as influenced by cropping system and weed management practices have been given in table 4.8.

Analysed data revealed that the plant population of groundnut were not significantly influenced by different cropping system and weed control treatments.

**4.1.1.3.2 Plant height**

Mean data on plant height of groundnut at different stages of crop growth as affected by cropping system and weed control methods have been presented in table 4.9.

Analysed data on pooled basis clearly indicated that the effect of cropping system on plant height at respective stages of growth were statistically non-significant (i.e. at 30, 60 days after sowing and at harvest) whereas different weed control treatments differed significantly among themselves. The interaction effect of cropping system and weed management practices was found to be statistically non-significant at all the stages of crop growth.

Different cropping system failed to bring any significant variation in plant height of groundnut at 30, 60 days after sowing and at harvest. However, maximum plant height of 23.98, 46.75 and 62.68 cm were recorded
when ground nut was grown with maize at 30, 60 days after sowing and at harvest, respectively.

All the weed management treatments significantly influenced the plant height of groundnut at different growth stages in both years. Based on pooled data, it was observed that the plots weeded thrice at 15, 30 and 45 days after sowing recorded significantly taller plants of groundnut i.e. 27.18, 52.95 and 68.65 cm, respectively at their respective stages of growth (30, 60 days after sowing and at harvest) and in turn were significantly superior to the rest of the weed control treatments.

However, at harvest the performance of pre-emergence application of oxyfluorfen @ 0.2 kg a.i. ha\(^{-1}\) in respect of plant height of groundnut was statistically alike with the performance of weeding thrice at 15, 30 and 45 days after sowing. Among the different weedicides, pre-emergence application of oxyfluorfen @ 0.2 kg a.i. ha\(^{-1}\) proved to be the best in performance followed by alachar @ 2.0 kg a.i. ha\(^{-1}\) as pre-emergence application in this regard. It was also observed that most of the chemical methods of weed management proved significantly superior to weedy control in all the stages of crop growth.

4.1.1.3.3 Number of nodules per plant

Analysed mean data (pooled) on number of nodules per plant in groundnut as affected by different cropping system and weed management practices at different stages of crop growth (30, 60 and 90 days after sowing) have been presented in table 4.10.

Perusal of data clearly indicated that the mean number of nodules per plant at the respective stages of crop growth was not significantly affected due to cropping system. Whereas different weed management practices had significant effect on number of nodules per plant of groundnut.

Cropping system failed to bring any significant variation in mean number of nodules per plant at respective stages of crop growth. However,
more number of nodules were recorded from the groundnut plant grown under intercropping system than the sole cropping of groundnut at all the three stages of crop growth (30, 60 and 90 days after sowing).

Weed management practices significantly influenced the number of nodules per plant at different stages of crop growth.

At 30, 60 and 90 days after sowing, weeding thrice (15, 30 and 45 days after sowing) resulted in the formation of highest number of nodules (17.41, 40.50 and 25.13 plant⁻¹, respectively), which were statistically at par with nodules per plant produced under the pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha⁻¹ (16.20, 38.91 and 23.36 plant⁻¹) at the respective stages of crop growth. These inturn were significantly superior to the rest of weed management practices under test. In addition to this, at 90 days after sowing the performance of oxyfluorfen @ 0.2 kg a.i.ha⁻¹ and alachlor @ 2.0 kg a.i.ha⁻¹, as pre-emergence application were statically alike in producing the nodules per plant in groundnut. Manual weeding as well as the chemical weed control treatments have been found significantly superior to weedy check in this regard.

4.1.1.3.4 Number of branches

The analysed data (pooled) on number of branches per plant of groundnut as influenced by different cropping system and weed control treatments have been given in the table 4.11.

Pooled data revealed that the effect due to different cropping system on number of branches per plant of groundnut was statistically non-significant. That means cropping systems failed to produce significant variations in number of branches per plant of groundnut crop.

Different weed management treatments produced significant variations in number of branches per plant of groundnut crop. The maximum mean number of branches (6.69) was recorded from the groundnut crops grown in
the plots where three manual weeding at 15, 30 and 45 days of sowing were done and inturn was significantly superior the rest of the chemical weed control treatments followed by the treatments of pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha⁻¹ (6.17) and alachlor @ 2.0 kg a.i.ha⁻¹ (5.62). All the weed control treatments showed their superiority over weedy check (4.92).

4.1.1.3.5 Number of pods per plant

Data on number of pods per plant of groundnut as influenced by cropping system and weed management practices have been presented in table 4.11.

The effect of cropping system on mean number of pods per plant of groundnut was found non-significant. Whereas, weed management practices differed significantly among themselves.

Cropping system failed to bring any significant variations in number of pods per plant of groundnut. However, more number of pods were recorded from the sole groundnut (26.00) as compared to intercropping of groundnut with maize (24.44), but the difference was non-significant.

Weed management practices significantly influenced the number of pods per plant. Weeding thrice at 15, 30 and 45 days after sowing recorded maximum number of pods per plant (30.28), which was significantly higher than the rest of the weed control treatments.

Among the herbicides, pre-emergence application of oxyfluorfen @ 0.20 kg a.i.ha⁻¹ recorded the maximum number of pods per plant (27.92) followed by pre-emergence application of alachlor @ 2.0 kg a.i.ha⁻¹ (26.30). Application of herbicides and hand weeding at respective growth stages showed their superiority over weedy check. Significantly lowest number of pods per plant in groundnut (19.08) was recorded under weedy check, where no weed management practices were adopted.
4.1.1.3.6 Effective pods per plant

The effect due to cropping system and weed management practices on effective pods per plant of groundnut as given in table 4.11 revealed that only weed management practices produced significant variations in effective pods per plant. Where, cropping system did not differed significantly among them selves in this regard.

Different cropping system failed to bring any significant variations in producing effective pods per plant of groundnut.

Different weed management practices significantly influenced the number of effective pods per plant of groundnut. Plots receiving three weeding at 15, 30, and 45 days after sowing produced highest number of effective pods per plant (22.69) and was significantly superior to the rest of the weed control treatments. Among the different herbicides, pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) produced more number of effective pods in groundnut (22.69), which inturn was comparable with effective number of groundnut pods recoded from the plots having treated with pre-emergence application of alachlor @ 2.0 kg a.i.ha\(^{-1}\) (19.45).

It was also observed that all the weed control treatments i.e. application of different herbicides along with manual weeding at respective stages of crop growth have been found significantly superior in performance to the weedy check.

4.1.1.3.7 Number of kernel per pod

Number of kernel per pod of groundnut was not affected significantly by different cropping system. However, intercropping system produced higher number of kernel per pod of groundnut than that of the pure stand of groundnut.
Different weed management practices produced significant variations in number of kernel per pod of groundnut. Maximum number of kernel per pod (2.55) were recorded from groundnut plants grown in the plots which received three weeding at 15, 30 and 45 days after sowing which inturn was statistically comparable with the number of kernels per pod obtained under pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha^{-1} (2.49) and alachlor @ 2.0 kg a.i.ha^{-1}.

It was further observed that the performance of alachlor and combined application of butachlor @ 1.5 kg a.i.ha^{-1}, as pre-emergence + quizolofop-ethyl @ 100 ml ha^{-1} as post-emergence application were statistically at par in respect of number of kernel per pod of groundnut. All the weed control treatments proved its superiority over weedy check in producing more number of kernel per pod of groundnut.

4.1.1.3.8 Sound matured kernel

Data on sound matured kernel of groundnut as presented in table 4.11 indicated that the influence of cropping system was non significant. Where as, weed control treatments significantly influenced the sound matured kernel of groundnut.

Cropping system did not significantly differ in producing sound matured kernel of groundnut. However, bold kernels were recorded from intercropping system (76.9%) as compared to sole cropping of groundnut (75.9%).

Weed control treatments significantly influenced the sound matured kernel of groundnut. Weeding thrice at 15, 30 and 45 days after sowing produced highest number of matured kernel (84.87%), which was comparable with matured kernel percentage (82.19%) recorded under pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha^{-1} and the performance of oxyfluorfen inturn was statistically at par with the performance of pre-emergence...
application of alachlor @ 2.0 kg a.i.ha\textsuperscript{-1} (79.28 %) in producing the sound matured kernels of groundnut.

\textit{4.1.1.3.9 Shelling percentage.}

Mean data (pooled) on shelling percentage of groundnut as influenced by cropping system and weed control treatments presented in table 4.11 revealed that cropping system did not produce any significant difference in shelling percentage of groundnut. Whereas, different weed control treatments produced significant variations in shelling percentage of groundnut.

Among the different weed control treatments weeding thrice at 15, 30 and 45 days after sowing recorded maximum shelling percentage of groundnut (76.13\%) and was statistically at par with shelling percentage (73.74\%) recorded under pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\textsuperscript{-1}. The shelling percentage obtained under weeding thrice and oxyfluorfen application were significantly superior to the rest of weed control treatments. However, the shelling percentage of groundnut obtained under the pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\textsuperscript{-1} and alachlor @ 2.0 kg a.i.ha\textsuperscript{-1} was statistically comparable. All the weed control treatment were significantly superior to the weedy check in respect of shelling percentage of groundnut.

\textit{4.1.1.3.10 100-kernel weight}

Analysed mean data (pooled) on 100-kernel weight of groundnut as influenced by different cropping system and weed control treatments have been presented in table 4.11.

The influence of cropping system on 100 kernel weight of groundnut was found non-significant, indicating that cropping system did not produce any significant variations in 100-kernel weight of groundnut.

100-kernel weight of groundnut was significantly influenced by weed management practices. The highest 100-kernel weight (34.33g) was recorded
under manual weeding thrice at 15, 30 and 45 days after sowing and was statistically at par with the 100- kernel weight obtained due to pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha$^{-1}$ (33.33g) and alachlor @ 2.0 kg a.i.ha$^{-1}$ (32.66g) which in turn were significantly superior to the rest of the weed control treatments under test. All the chemical methods including manual weeding showed their superiority over weedy check.

4.2 STUDIES ON WEEDS

4.2.1 Weed Flora

Details of weed flora associated with maize based intercropping system are presented in table 4.12.

The experimental plots were infested both with monocot (grasses) and dicot (Broad leaved) weeds.

4.2.1.1 Monocot weeds

The most predominant weeds observed in the experimental plots were *Cynodon dactylon* (L.) pers, *Dactyloctenium aegyptium* (L.) willd, *Echinochloa colonum* (L.) Link, *Echinochloa crusgalli* (L.) Beauv, *Eleusine indica* (L.) Gaertn, *Panicum repens* (L.)

4.2.1.2 Dicot weeds


4.2.1.3 Sedges

Among the different species of sedges, *Cyperus rotundus* L. was found to be associated with crop field.
4.2.2 Weed count

Data on weed count per square metre at different growth stages of crops as influenced by cropping system and weed management practices have been presented in table 4.13.

The effect due to different cropping system and weed management practices along with their interaction effect on weed population at different stages of crop growth were found to be statistically significant.

The influence of cropping systems on weed density were significant at all the three growth stages of crop. Analysed data (pooled) clearly indicated that significantly least population of weeds (21.5, 37.05 and 45.53 m\(^{-2}\)) in maize + soybean intercropping systems followed by maize + groundnut intercropping (23.01, 43.44 and 51.32 m\(^{-2}\)) were recorded at 30, 60 and 90 days after sowing, respectively. Raising of maize, soybean and groundnut in pure stands as well as maize + groundnut proved to be significantly inferior to maize + soybean intercropping in suppressing the population of weeds at all the three stages of crop growth.

All the weed management practices significantly influenced the weed population at all the stages of crop growth. Pooled data of both the year of experimentations revealed that weedy condition produced maximum weed density (74.40, 121.00 and 130.95 m\(^{-2}\)) at all the stages of crop growth i.e. 30, 60 and 90 days after sowing, respectively.

Plots receiving three hand weeding at 15, 30 and 45 days after sowing recorded significantly lower weed density (13.80, 24.45 and 31.54 m\(^{-2}\)) at 30, 60 days after sowing and at harvest, respectively than rest of the treatments. Among the herbicides used, oxyfluorfen @ 0.2 kg a.i. ha\(^{-1}\), as pre-emergence application recorded significantly lower weed populations (17.05, 27.88 and 34.70 m\(^{-2}\)) followed by the pre-emergence application of alachlor @ 2.0 kg
a.i.ha\(^{-1}\) (21.24, 30.02 and 37.61 m\(^{-2}\)) at all the stages of crop growth as mentioned above.

Among the herbicides under test, the performance of combined application of Butachor @ 1.50 kg a.i.ha\(^{-1}\), as pre-emergence + Quizalofop – ethyl @ 100 ml ha\(^{-1}\) as post-emergence was inferior to rest of the herbicides used in suppressing weed population at all the stages of crop growth.

The interaction effect of cropping system and weed management practices on weed density at different days after sowing were found to be statistically significant.

At 30 days after sowing, the minimum density of weeds (17.50 m\(^{-2}\)) was recorded from the plots where maize was intercropped with soybean along with weeding thrice at 15, 30 and 45 days after sowing and it was statistically comparable with pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) (21.17 m\(^{-2}\)) and Alachlor @ 2.0 kg a.i.ha\(^{-1}\) (21.92 m\(^{-2}\)) and these combinations in turn were statistically at par in performance observed under maize + groundnut intercropping system with the weeding thrice (28.48 m\(^{-2}\)), along with pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) (32.33 m\(^{-2}\)) and alachlor @ 2.0 kg a.i.ha\(^{-1}\). The performance of these weed management practices under both the intercropping system in suppressing or reducing the number of weeds were significantly superior to the rest of the treatment combinations (table 4.13.1).

The similar trend in respect of weed density as influenced by interaction effect of cropping system and weed management practices at 60 days after sowing was observed (table 4.13.2). But at 90 days after sowing, the performance of weed management practices i.e. weeding thrice at 15, 30 and 45 days after sowing and pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) under both the intercropping system i.e. Maize + Soybean and maize + groundnut was statistically at par in reducing the weed density and these in turn were significantly superior to the performance of rest of the weed
management practices under different cropping system in reducing the population of weeds (4.13.3).

**4.2.3 Dry matter accumulation by weeds**

The data on dry weight of weeds at different growth stages as influenced by cropping system and weed management practices have been presented in table 4.14.

The effect of cropping system and weed management practices on dry matter accumulation by weeds was found to be statistically significant at different stages of crop growth. Where as their interaction effect was found significant only at 60 and 90 days after sowing.

Cropping system significantly affected the dry matter accumulation by weeds at different growth stages of crop. It was clear from the analyzed data (pooled of both years) that intercropping systems significantly restricted the dry matter accumulation by weeds at 30, 60 and 90 days after sowing of the crop compared to sole cropping.

Maize + Soybean intercropping being statistically at par with maize + groundnut intercropping resulted in significantly lower weed dry matter.

At all the stages of crop growth i.e., on 30 and 60 days after sowing and at harvest, minimum dry matter production by weeds (11.42gm, 13.88 gm and 15.19gm m⁻² respectively) were recorded from the plots of maize + soybean intercropping which was statistically at par with the values of dry matter production by weeds (12.56 g, 15.79 and 16.60 g m⁻²) under maize + groundnut intercropping system at respective growth stages of crop. These recorded values of dry matter production by weeds at 30, 60 and 90 days after sowing interturn were significantly superior to the value of dry matter production by weeds under sole cropping of maize (16.08g, 22.22g and 24.51g m⁻²), soybean (14.18g, 20.16g and 21.96 g m⁻²) and ground nut (15.80g, 20.04g and 23.69 g m⁻²) at the respective stages of crop growth. It was further
observed that dry matter production by weeds under sole cropping of maize, soybean and groundnut were statistically at par irrespective of the different stages of crop growth.

All the weed management practices significantly reduced the dry matter production by weeds over weedy check at different stages of crop growth. Among the weed control treatments, weeding thrice by hand at 15, 30 and 45 days after sowing produced minimum weed dry weight (10.51; 12.72 and 14.89 g m$^{-2}$) at 30, 60 and 90 days after sowing which was statistically at par with the dry weight of weeds recorded under pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha$^{-1}$ (10.82, 13.65 and 15.37 g m$^{-2}$) at the respective stages of crop growth and these recorded values of dry weight of weeds were significantly superior to the dry weight values recorded under rest of the herbicide applied i.e. Alachlor @ 2.0 kg a.i.ha$^{-1}$ as pre-emergence and Butachlor @ 1.5 kg a.i.ha$^{-1}$ as pre-emergence Quizalofop-ethyl @ 100 ml ha$^{-1}$, as post emergence application.

Interaction effect of cropping system and weed management practices on dry matter accumulation by weeds at 60 days after sowing and at 90 days after sowing was also found significant. At 60 days after sowing maize+soybean intercropping plots recorded minimum weed dry weight (9.00 g m$^{-2}$), when performed by weeding thrice i.e. at 15, 30 and 45 days after sowing and was statistically at par with dry weight of weeds (9.55 g m$^{-2}$) recorded under maize + soybean intercropping with the pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha$^{-1}$ and alachlor @ 2.0 kg a.i.ha$^{-1}$ and was statistically at par with the dry weight of weeds recorded from maize + groundnut intercropping with weeding thrice (10.50 g m$^{-2}$), pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha$^{-1}$ (11.50 g m$^{-2}$) and alachlor @ 2.0 kg a.i.ha$^{-1}$ (12.50 g m$^{-2}$). These inturn was significantly superior to the rest of the treatment combinations under test (table 4.14.1).
It was further observed that intercropping of maize + soybean and maize+ groundnut along with weed management practices have been found very effective in reducing the dry matter accumulation on weeds.

Similar trend in dry matter accumulation by weeds as influenced by the interaction effect of cropping system and weed management practices at 90 days after sowing has bean also found. It was further observed that the weed management practices viz. weeding thrice, pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) and alachlor @ 2.0 kg a.i.ha\(^{-1}\) performed well in reducing the dry weight of weeds under both the cropping system i.e. maize + soybean and maize + groundnut intercropping registering the weed dry weight of 10.25 g m\(^{-2}\), 10.90g m\(^{-2}\), 11.39g m\(^{-2}\) and 11.50g m\(^{-2}\), 11.95g m\(^{-2}\) and 12.40 g m\(^{-2}\), respectively (table 4.14.2).

### 4.2.4 Weed control efficiency

Pooled data on weed control efficiency at 30, 60 and 90 days after sowing as influenced by cropping system and weed management practices have been given in table 4.15.

Cropping system had influence on weed control efficiency at all the three stages of crop growth. Maize + soybean (1:2) intercropping system had maximum weed control efficiency (51.21, 59.5 and 60.10%, respectively) followed by maize+groundnut (1:2) intercropping system (46.52, 53.96 and 56.52%, respectively) at all the three stages of crop growth i.e., at 30, 60 and 90 days after sowing. Among the sole crops, soybean in pure stand recorded the maximum weed control efficiency at their respective stages of growth except at 60 days after sowing. Lowest weed control efficiency was recorded under sole maize grown in pure stand at their respective growth stages. It was further observed that the performance of intercropping systems was found better than either of their sole cropping.
Weed management treatments had positive effect on weed control efficiency at all the three stages of crop growth. Hand weeding at 15, 30 and 45 days after sowing recorded maximum weed control efficiency (55.12, 62.91 and 61.02%, respectively) at 30, 60 and 90 days after sowing closely followed by the pre-emergence application of oxyfluorfen @ 0.2 kg a.i. ha$^{-1}$ (53.70, 60.25 and 59.77%, respectively) at their respective stages of growth.

**4.2.5 Weed index and weed seed rain**

Data on weed index and seed rain as influenced by cropping system and weed management practices have been presented in table 4.16.

Pooled value of weed index and weed seed rain indicated that the cropping system had positive influenced on weed index value and weed seed rain. It was observed that intercropping system recorded lower value of weed index and weed seed rain as compared to sole cropping. Maize + soybean (1:2) intercropping system recorded the least value of weed index (3.90%) followed by pure stand of ground (36.69%) and soybean (41.97). Pure stand of maize recorded the highest weed index value of 45.31% among the different cropping system.

All the weed management treatments influenced the weed index values. Weeding thrice at 15, 30 and 45 days after sowing recorded the lowest value of weed index (11.47%) closely followed by pre-emergence application of oxyfluorfen @ 0.2 kg a.i. ha$^{-1}$ (15.21%) and alachlor @ 2.0 kg a.i. ha$^{-1}$ (20.08%). Weedy check recorded the maximum value of weed index (48.54%) (table 4.16).

Similarly, the lowest weed seed rain value (131875 m$^{-2}$) was obtained from maize + soybean intercropping system followed by maize + groundnut intercropping system recording the weed seed rain value (314444.3 m$^{-2}$). Maize, soybean and groundnut grown in pure stand recorded comparatively highs value of weed seed rain in descending order of their sequence.
All the weed control treatments influenced the weed index and weed seed rain value and recorded comparatively lower value as compared to weedy check. Among the weed management practices, manual weeding thrice at 15, 30 and 45 days after sowing recorded lowest value of weed seed main (158341.5 m$^{-2}$) followed by the herbicides applied i.e., oxyfluorfen @ 0.2 kg a.i.ha$^{-1}$, as pre-emergence, alachlor @ 2.0 kg a.i.ha$^{-1}$, and Butachlor @ 1.5 kg a.i.ha$^{-1}$ pre-emergence + Quizalofop ethyl @ 100 ml ha$^{-1}$, as post-emergence application in ascending order of their value recorded in sequence. It was further observed that among herbicides used, oxyfluorfen and alachlor have been found as effective as manual weeding (15, 30 and 45 days of sowing) in recording the lower value of weed index and weed seed rain.

### 4.3 YIELD

#### 4.3.1 Maize

The mean data on grain, Stover and stone yield of maize as well as harvest index as influenced by cropping system and weed management practices have been presented in table 4.17.

#### 4.3.1.1 Grain

Analysis of pooled data revealed that the effect of cropping system and different weed management practices was found to be statistically significant.

It was also observed that the cropping system did not produced significant variations in grain yield of maize during both year of experimentation.

Based on pooled analysis, significant variations in grain yield of maize due to different cropping system was observed. Maximum grain yield of 3605 kg ha$^{-1}$ was obtained from pure stand of maize and was statistically at par with the mean grain yield of 3466 kg ha$^{-1}$ recorded from maize + soybean intercropping system which inturn were significantly superior to the mean
grain yield of maize + groundnut intercropping system (3205 kg ha\(^{-1}\)). Grain yield obtained under maize + soybean and maize + groundnut intercropping system was 3.85% and 11.09% less than that of the grain yield obtained under sole cropping of maize.

All the weed management practices significantly enhanced the grain yield of maize as compared to weedy check. Maximum mean grain yield of maize (4036 kg ha\(^{-1}\)) was recorded from the plots that received three weeding at 15, 30 and 45 days after sowing and was statistically comparable with the mean grain yield of maize (3933 kg ha\(^{-1}\)), obtained from the plots treated with oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\), as pre-emergence application. Which in turn was significantly superior to the rest of the weed control treatments. It was also observed that the mean grain yield (3766 kg ha\(^{-1}\)) obtained under pre-emergence application of alachlor @ 2.0 kg a.i.ha\(^{-1}\) were statically at par with the mean grain yield obtained under pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\). Significantly lowest mean grain yield of 2105 kg ha\(^{-1}\) was recorded from weedy check i.e., where no weed management practice was followed. Among the herbicides used, combined application of butachlor @ 1.5 kg a.i.ha\(^{-1}\), as pre-emergence + quizalofop – ethyl @ 100 ml ha\(^{-1}\), as post emergence application proved inferior to the rest of the herbicides in respect of grain yield of maize (3286 kg ha\(^{-1}\)). However, all the weed management practices showed their superiority over weedy check in producing grain yield of maize.

4.3.1.2 Stover

Analysis of pooled data on stover yield of maize as influenced by cropping system and weed control treatments presented in table 4.17 revealed that cropping system and different weed management practices significantly influenced the stover yield of maize. However, the effect of cropping system on stover yield was found non-signification during the year 2005.
Pure stand of maize produced maximum stover yield (7268 kg ha\(^{-1}\)) and was statistically at par with the stover yield obtained under maize + soybean intercropping system (6928 kg ha\(^{-1}\)), which in turn were significantly superior to the stover yield (6472 kg ha\(^{-1}\)) obtained from maize + groundnut intercropping system.

All the weed control treatments significantly increased the stover yield of maize to weedy check. Plots weeded thrice at 15, 30 and 45 days after sowing produced maximum stover yield of maize (7858 kg ha\(^{-1}\)) and was statistically comparable with the stover yield obtained under pre-emergence application of oxyfluorfen @ 0.20 kg a.i. ha\(^{-1}\) (7694 kg ha\(^{-1}\)) and alachlor @ 2.0 kg a.i. ha\(^{-1}\) (7462 kg ha\(^{-1}\)), which in turn were significantly superior to the rest of weed control treatments. Significantly lowest stover yield of maize (4559 kg ha\(^{-1}\)) was recorded from weedy check.

4.3.1.3 Stone

Analysed pooled data on stone yield of maize as influenced by different cropping system and weed management as given in table 4.17 indicated that the effect due to cropping system was non-significant where as weed management significantly influenced the stone yield of maize. However, stone yield of maize was not significantly influenced by weed management practices during both year of experimentation.

Stone yield obtained due to all the weed management practices were statically at par and were significantly superior to weedy check.

4.3.1.4 Harvest index

Analysed data (pooled) on harvest index of maize as influenced by cropping system and weed management practices given in table 4.17 revealed that the effect of cropping system failed to produce any significant difference in harvest index of maize. However, both the intercropping system i.e., maize
soybean and maize+ groundnut recorded numerically higher value of harvest index (.310 and .309) than the pure stand of maize (.308).

Pooled value of harvest index was significantly influenced by weed management practices. However, the effect of weed management practices on harvest index of maize were found non-significant during both year experimentation.

Maximum value of harvest index (.317) was recorded from weeding thrice at 15, 30 and 45 days after sowing and was statistically at par with the value of harvest index recorded under all the chemical weed control treatments under test. It was also observed that all the weed control treatments proved their superiority over weedy check in respect of harvest index of maize.

4.3.2 Soybean

The pooled data on grain and straw yields as well as on harvest index of soybean as influenced by cropping system and weed management practices have been presented in table 4.18.

4.3.2.1 Grain

Cropping system significantly influenced the grain yield of soybean. Pure stand of soybean produced maximum yield 2389 kg ha⁻¹ and was significantly superior to the grain yield obtained under maize + soybean intercropping system (1800 kg ha⁻¹). The yield obtained under sole cropping of soybean was 24.65% higher than the yield of soybean obtained under maize + soybean intercropping system.

All the weed management treatments significantly influenced the grain yield of soybean. Plots weeded thrice at 15, 30 and 45 days after sowing produced maximum grain yield of soybean (2472 kg ha⁻¹) being statically at par with the grain yield (2341 kg ha⁻¹) obtained from the plots treated with pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha⁻¹. Which inturn was
significantly superior to the grain yield obtained under rest of the weed control treatments. The next best herbicide in respect of obtaining grain yield of soybean was alachlor, when applied @ 2.0 kg a.i.ha\(^{-1}\), as pre-emergence application.

All the weed control treatments were significantly superior to weedy check in obtaining higher grain yield of soybean.

**4.3.2.2 Straw**

Two years pooled data on straw yield of soybean as influenced by cropping system and weed management practices presented in table 4.18 revealed that the treatments differed significantly among themselves in obtaining straw yield of soybean. Pure stand of soybean produced significantly higher straw yield (5233 kg ha\(^{-1}\)) than maize + soybean intercropping system (3872 kg ha\(^{-1}\)). Straw yield obtained under sole cropping of soybean was 26% higher than that of the straw yield obtained under maize + soybean intercropping system.

Weed management practices significantly influenced the straw yield of soybean. Plots having minimum infestation of weeds due to weeding thrice at 15, 30 and 45 days after sowing obtained maximum straw yield (5252 kg ha\(^{-1}\)) and was statistically comparable with the straw yield (5055 kg ha\(^{-1}\)) recorded under oxyfluorfen when applied @ 0.2 kg a.i.ha\(^{-1}\) as pre-emergence which in turn was significantly superior to the rest of the weed management practices. Plots infested with high weed density i.e. weedy check recorded the lowest straw yield (3744 kg ha\(^{-1}\)) of soybean and was inferior in performance to the rest of the weed control treatments.

**4.3.2.3 Harvest index**

Analysis of pooled data on harvest index of soybean presented in the table 4.18 indicated that the effect of different cropping system on harvest
index of soybean was statistically non-significant but the effect due to different weed management practices was found significant.

Cropping system did not significantly differed among themselves in respect of harvest index of soybean. However, sole soybean recorded higher harvest index (.312) than that obtained under maize + soybean intercropping system (.311).

Weed control treatment had significant effect on harvest index of soybean. Maximum harvest index (.320) was recorded from the plots which were kept with minimum density of weeds by hand weeding thrice at 15, 30 and 45 days after sowing and was statistically at par with the harvest index of soybean recorded under rest of the weed control treatments. All the weed control treatments performed equally good in recording harvest index of soybean and were significantly superior to the weedy check in this regard.

4.3.3 Groundnut

4.3.3.1 Yield

The data (pooled) on pod and haulm yield as well as on harvest index of groundnut as influenced by cropping system and weed management practices have been presented in table 4.19.

4.3.3.1.1 Pod

The effect of cropping system and weed management practices on pod yield of groundnut was found significant.

Cropping system significantly influenced the yield of groundnut. Pure stand of groundnut produced maximum pod yield (1902 kg ha\(^{-1}\)) and was significantly superior to the pod yield obtained under maize + groundnut intercropping (1546 kg ha\(^{-1}\)).

All the weed management treatments significantly increased the pod yield of groundnut over the weedy check. However, plots weeded thrice at 15,
30 and 45 days after sowing produced maximum pod yield of groundnut (2083 kg ha\(^{-1}\)) being statistically at par with the pod yield obtained under pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) (1980 kg ha\(^{-1}\)) and in turn was significantly superior to the pod yield obtained under rest of the weed management treatments. It was also observed that the performance of pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) and alachlor @ 2.0 kg a.i.ha\(^{-1}\) was equally effective in recording the pod yield of groundnut. However, the performance of pre-emergence application of butachlor @ 1.5 kg a.i.ha\(^{-1}\) + quinalofop-ethyl @ 100 ml ha\(^{-1}\), as post-emergence was inferior to the rest of the chemical weed control methods. The plots without having any weed management practices recorded the lowest pod yield of groundnut (1255 kg ha\(^{-1}\)).

4.3.3.1.2 Haulm

The pooled data on haulm yield as given in table 4.19 revealed that the effect due to cropping system and weed control treatments was found to be statistically significant.

Cropping system significantly influenced the haulm yield of groundnut. Maximum haulm yield (3905 kg ha\(^{-1}\)) was obtained from groundnut sole cropping and was significantly superior to the haulm yield (3102 kg ha\(^{-1}\)) obtained from maize + groundnut intercropping system.

Different weed management practices significantly influenced the haulm yield of groundnut. Maximum haulm yield (4044 kg ha\(^{-1}\)) was recorded from the plots, where three weeding were done at 15, 30 and 45 days after sowing and was statistically comparable with haulm yield obtained from the plots, having treated with herbicide oxyfluorfen @ 0.0 kg a.i.ha\(^{-1}\) as pre-emergence application. Similarly the haulm yield obtained under pre-emergence of alachlor @ 2.0 kg a.i.ha\(^{-1}\) was statically at par with the haulm yield obtained due to pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\).
a.i. ha\(^{-1}\). Significantly lowest haulm yield (2933 kg ha\(^{-1}\)) was recorded from the weedy check.

4.3.3.1.3 Harvest index

The effect of cropping system on harvest index of groundnut was non-significant as indicated by the pooled data presented in table 4.19 whereas all the weed control treatments were found statistically significant in this regard.

Though the cropping system did not produce any significant variations in harvest index of groundnut. Maize + groundnut intercropping system recorded slightly higher harvest index value (0.330) than that of the sole cropping of groundnut (0.327).

All the weed control treatments significantly influenced the harvest index of groundnut. Weeding thrice at 15, 30 and 45 days after sowing being statistically at par with all the chemical weed control methods recorded maximum harvest index of groundnut (.320) and in turn all the weed control treatments were significantly superior to the harvest index of groundnut recorded under weedy check (.293), indicating that all the weed management treatments behaved in a similar manner in producing their effect on harvest index of groundnut.

4.3.3.1.4 Maize Equivalent Yield

The pooled data on maize equivalent yield as influenced by different cropping system and weed management practices have been presented in table 4.20.

The effect due to cropping system and weed management treatments on maize equivalent yield was found to be statistically significant. It was also observed that the interaction effect of cropping system and weed management practices also produced significant differences in maize equivalent yield.
The maize equivalent yield was significantly influenced by cropping system. The maximum maize equivalent yield (6608 kg ha\(^{-1}\)) was obtained with maize + groundnut intercropping system which was statistically at par with the equivalent yield (6344 kg ha\(^{-1}\)) recorded under maize + soybean intercropping system and inturn both the intercropping systems proved significantly superior to sole cropping either of crops. Sole cropping of groundnut gave significantly higher maize equivalent yield being statistically comparable with the equivalent yield (3836 kg ha\(^{-1}\)) of sole soybean. Maize equivalent yield of sole maize (3605 kg ha\(^{-1}\)) was statistically comparable with the maize equivalent yield of sole cropping of soybean.

All the weed control treatments significantly enhanced the maize equivalent yield over the weedy check. Plots weeded thrice at 15, 30 and 45 days after sowing produced the highest maize equivalent yield (5602 kg ha\(^{-1}\)) obtained from the plots having treated with pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\), which inturn was significantly superior to the maize equivalent yield recorded under rest of the weed control treatments. Weed management practices under test showed their superiority over weedy check in respect of maize equivalent yield.

The interaction effect of cropping systems and weed management treatments on maize equivalent yield as presented in table 4.20.1 was found to be significant.

Maximum maize equivalent yield (8039 kg ha\(^{-1}\)) was obtained under maize + groundnut intercropping system being statistically at par with the maize equivalent yield (7489 kg ha\(^{-1}\)) of maize + soybean intercropping system from the plots which were kept almost weed free situation or with lowest weed density by giving three weeding at 15, 30 and 45 days after sowing. Both the intercropping system also performed equally well under the pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) in obtaining the maize equivalent
yield. Which in turn were significantly superior to the rest of weed control treatments.

**4.4 Competition studies**

**4.4.1 Land equivalent ratio**

The pooled data presented in table 4.20 revealed that the intercropping systems increased the land equivalent ratio, though the difference of land equivalent ratio between the two intercropping systems was very marginal. Maize + soybean intercropping system recorded higher value (1.71) than that of the LER value (1.70) obtained from maize + groundnut intercropping.

All the weed management treatments increased land utilization over weedy check. Weeding thrice and pre-emergence application of oxyfluorfen @ 0.2 kg a.i. ha\(^{-1}\) recorded the maximum land equivalent ratio (1.73) by both the weed control treatments closely followed by pre-emergence application of alachlor @ 2.0 kg a.i. ha\(^{-1}\) (1.70) and combined application of butachlor @ 1.5 kg a.i. ha\(^{-1}\), as pre-emergence + quizalofop-ethyl @ 100 ml ha\(^{-1}\), as post-emergence application (1.69). Weed management treatments were superior to weedy check (1.66) in the land utilization by the crops.

**4.4.2 Competitive ratio**

Pooled data of competitive ration indicated that the intercropping system influenced the competitive ratio. Maize + Soybean (1:2) intercropping system recorded higher value of competitive ratio (2.54) compared to maize + groundnut (1:2) intercropping system. However, the difference in competitive ratio values recorded under maize + soybean and maize + groundnut intercropping systems indicated that both the intercropping system proved to be equally good.

Per-emergence application of oxyfluorfen @ 0.2 kg ha\(^{-1}\) recorded higher value of competitive ratio (2.47) closely followed by weeding thrice at 15, 30
and 45 days after sowing (2.37) of competitive ratio (2.27) was recorded under weedy check (table 4.21).

4.4.3 Aggressivity

In maize + soybean (1:2) intercropping system, the higher (positive) value of aggressively (0.58) indicated that maize crop was more dominant over the soybean. While maize + groundnut intercropping system recorded comparatively lesser value of aggressively (0.45) than that of the maize + soybean intercropping system, thereby indicating that maize was less dominant over groundnut compared to soybean.

Among the weed control treatments weedy check recorded the minimum value of aggressivity (0.50) indicating that dominancy of component crops could be minimized by suitable intercropping system and weed control measures and the cropping system may be made more remunerative.

4.4.4 Competition index

Maize + Soybean intercropping system recorded the lowest value of competition index almost nil compared to maize + groundnut intercropping system registered the mean value of competition index (0.06) thereby indicating that competition offered by soybean with maize or the competition between maize and soybean intercropping system was almost negligible when compared with maize + groundnut intercropping system hence, maize + soybean intercropping system was comparatively more beneficial than maize + groundnut intercropping system.

Since the value of competition index recorded under both the intercropping system differed marginally, it could be interpreted that both the intercropping system i.e., maize + soybean and maize + groundnut proved equally good indicating that soybean and groundnut were equally compatible with maize.
Among the different weed control treatment, weeding thrice at 15, 30 and 45 days after sowing being equally comparable with pre-emergence application of oxyfluorfen @ 0.2 kg a.i. ha\(^{-1}\) and alachlor @ 2.0 kg a.i. ha\(^{-1}\) recorded the lowest value of competition index than that of the rest of the weed control treatment.

However, different weed management practices differed minimally among themselves on respect of aggressivity values. Data further indicated that the maize dominated by the component crops i.e. intercrops (Soybean and groundnut) could be minimized by a suitable weed control measure and the cropping system may be made more remunerative.

**4.5 LIGHT INTERCEPTION (%)**

The mean data on mean light interception (%) at different growth stages of crops as influenced by cropping system and weed management practices have been presented in table 4.22.

The analysed data (pooled) on mean light interception (%) at different growth stages (30, 60 and 90 days after sowing) of crops as revealed that the effect due to different cropping systems and weed control treatments were statistically significant. Whereas their interaction effect was found to be non-significant.

Different cropping systems significantly influenced the interception of light by the crops at all the stages of crop growth. Maximum light was intercepted by maize + soybean intercropping system at their respective stages of crop growth i.e. at 30, 60 and 90 days after sowing (58.68, 90.53 and 88.46\% respectively) and were significantly superior to the rest of the cropping system, followed by maize + groundnut intercropping system registering the mean value of light interception (54.42, 83.77 and 79.84\%) at the respective stages of crop growth.
Among the sole cropping, pure stand of maize crop intercepted the maximum light (43, 68.15 and 60.20%) at all the three stages of crop growth i.e., 30, 60, and 90 days after sowing and these value of light interception was significantly superior to the value of light interception recorded under sole soybean and groundnut at the respective stages of crop growth.

Various weed management practices produced significant variations in mean light interception at all the three stages of crop growth (30, 60, and 90 days after sowing). Maximum light interception was recorded under the plots weeding thrice at the respective stages of crop growth (49.93, 77.06 and 57.45%) and inturn were statistically at par with the mean value of light interception recorded under weed control treatment of pre-emergence application of oxyfluorfen @ 0.2 kg a.i. ha\(^{-1}\) at 60 and 90 days after sowing (74.91 and 55.49%, respectively) and these value inturn was significantly superior to the rest of the chemical treatment. All the weed control treatments i.e. chemical and manual weeding proved to be significantly superior to weedy check at all the respective crop growth stages.

**4.6 N.P.K. UPTAKE**

**4.6.1 Crops**

The pooled data of both years experimentations on nitrogen, Phosphorus and potassium uptake by crops at harvest as influenced by cropping system and weed management have been presented in table 4.23.

**4.6.1.1 Nitrogen**

The analysed pooled data on total nitrogen up take by crops indicated that the effect of different cropping system and weed management practices as well as their interaction effect were statistically significant.

Cropping system significantly influenced the total nitrogen up take of crops. Maize + soybean intercropping system recorded highest nitrogen
uptake 241.38 kg ha\(^{-1}\) and was significantly superior to the rest of the cropping system. Pure stand of maize, soybean and groundnut recorded significantly lower nitrogen uptake than the intercropping system. Nitrogen uptake by crops in maize + soybean intercropping system was 30.46, 62.72, 53.72 and 12.20 per cent higher than the uptake of maize + groundnut intercropping, sole maize, sole ground nut and sole soybean, respectively.

All the weed management treatments significantly increased the nitrogen uptake by crop over the weedy check. Plots weeded thrice at 15, 30 and 45 days after sowing recorded maximum nitrogen uptake (192.77 kg ha\(^{-1}\)) and was statistically at par with the pre-emergence application of oxyfluorfen @ 0.2 kg a.i. ha\(^{-1}\) (184.69 kg ha\(^{-1}\)). It was further observed that the nitrogen uptake by the crop under the treatment of pre-emergence application of alachlor @ 2.0 kg a.i. ha\(^{-1}\) was statistically comparable with nitrogen uptake of crops under pre-emergence application of oxyfluorfen @ 0.2 kg a.i. ha\(^{-1}\). Among the herbicides, combined application of butachlor @ 1.5 kg a.i. ha\(^{-1}\), as pre-emergence + quizalafop-etyl @ 100 ml ha\(^{-1}\), as post-emergence application recorded comparatively lows nitrogen uptake of crops (149.54 kg ha\(^{-1}\)).

Interaction effect of cropping system and weed control treatments significantly influenced the total nitrogen uptake of crops. Maize + soybean intercropping system recorded the highest total nitrogen uptake (283.87 kg ha\(^{-1}\)) under the treatment of weeding thrice at 15, 30 and 45 days after sowing and was significantly superior to the rest of treatment combinations (table 4.23.1).

4.6.1.2 Phosphorus

The pooled data on total phosphorus uptake by crops as influenced by cropping system and weed management treatments has been presented in table 4.23.
The pooled analysed data relating to total phosphorus uptake by crops revealed that the cropping system, weed management treatments and their interaction differed significantly in respect of total uptake of phosphorus by crops.

Cropping system significantly influenced the total uptake of phosphorus by crops. Significantly highest uptake of phosphorus 33.35 kg ha\(^{-1}\) was recorded under maize + groundnut intercropping system followed by maize + soybean intercropping (29.98 kg ha\(^{-1}\)). The lowest uptake of phosphorus (14.60 kg ha\(^{-1}\)) was recorded under sole soybean followed by groundnut (19.55 kg ha\(^{-1}\)) and maize (20.62 kg ha\(^{-1}\)) in their pure stand. However, the total uptake of phosphorus by crops under sole cropping of maize and groundnut was statistically comparable to each other.

All the weed management treatments significantly increased the phosphorus uptake by crop compared to weedy cheek. Crop weeded thrice at 15, 30 and 45 days after sowing recorded maximum phosphorus uptake by crops (28.45 kg ha\(^{-1}\)) and was statistically at par with the value of total phosphorus uptake (27.37 kg ha\(^{-1}\)) recorded under the treatment of pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) and inturn were significantly superior to the rest of the weed control treatments.

Interaction of cropping system and weed control treatments significantly influenced the total phosphorus uptake of crops. Maize + groundnut intercropping recorded maximum phosphorus uptake by crops (40.58 kg ha\(^{-1}\)), when weeded thrice at 15, 30 and 45 days after sowing and which was statistically comparable with pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) and inturn were superior to the rest of the weed control treatments (table 4.23.2).
4.6.1.3 Potassium

The pooled data of both year experiments on total potassium uptake by the crop as affected due to cropping system and weed management treatments have been given in table 4.23.

Analysed data (pooled) on total potassium uptake revealed that the effect of cropping system, weed control treatment as well as their interaction was statistically significant.

Different cropping system significantly influenced the total potassium uptake by crops. Based on pooled data it was observed that maize + soybean intercropping system recorded significantly highest potassium uptake (137.66 kg ha\(^{-1}\)) followed by maize + groundnut intercropping system (114.51 kg ha\(^{-1}\)). Among the crops grown in pure stand, sole cropping of maize uptake maximum potassium (84.38 kg ha\(^{-1}\)) and was significantly superior to the sole cropping of soybean (75.41 kg ha\(^{-1}\)) and groundnut (55.62 kg ha\(^{-1}\)). Intercropping systems were significantly superior to the sole cropping in respect of total potassium uptake.

Weed management treatments significantly influenced the total potassium uptake by crops. Plots weeded thrice at 15, 30 and 45 days after sowing recorded significantly highest potassium uptake (110.71 kg ha\(^{-1}\)) followed by pre-emergence application of oxyfluorfen @ 0.2 kg a.i. ha\(^{-1}\) (101.56 kg ha\(^{-1}\)) and alachlor @ 2.0 kg a.i. ha\(^{-1}\) (100.23 kg ha\(^{-1}\)). However, potassium uptake by the crops under pre-emergence application of oxyfluorfen and alachlor at their respective doses were statistically comparable and in turn were superior to the performance of combined application of butachlor @ 1.5 kg a.i. ha\(^{-1}\), as pre-emergence + quizalofop-ethyl @ 100 ml ha\(^{-1}\), as post-emergence application.

All the weed management treatments proved to be superior to weedy check in respect of total uptake of potassium by crops.
Interaction of cropping system and weed control treatments significantly influenced the total potassium uptake by crops. Maize + soybean inter cropping system recorded maximum uptake of total potassium by crops (160.61 kg ha\(^{-1}\)), when weeded thrice at 15, 30 and 45 days after sowing followed by maize + ground nut under the same weed management practices i.e. weeding thrice and was significantly superior to the rest of the weed management and cropping system combinations (table 23.3).

### 4.6.2 Weeds

#### 4.6.2.1 Nitrogen

Data on nitrogen uptake by weeds in kg ha\(^{-1}\) at different (30, 60 and 90) days after sowing as influenced by cropping system and weed management have been presented in table 4.24. The analysed data on pooled basis of two years experimentation revealed that the effect due to cropping system and weed management practices were statistically significant at all the respective stages. Where as their interaction effect were found to be significant only at 60 and 90 days after sowing.

Cropping system significantly influenced the nitrogen uptake by weeds. Maize + soybean intercropping system (2.96, 3.41 and 1.89 kg ha\(^{-1}\)) being statistically at par with maize + groundnut intercropping (3.30, 3.41 and 2.12 kg ha\(^{-1}\)) significantly reduced the nitrogen uptake by weeds at 30, 60 and 90 days after sowing and these intercropping systems were significantly superior to the rest of cropping system. Intercropping system have been found effective in reducing the nutrient depletion by weeds than that of the sole cropping at all the respective stages (30, 60 and 90 days after sowing). Similarly, different weed management treatments also significantly reduced the nitrogen uptake by weeds as compared to weedy check at 30, 60 and 90 days after sowing. Weeding thrice at 15, 30 and 45 days after sowing recorded the least nitrogen
uptake by weeds (2.75, 2.88 and 1.87 kg ha\(^{-1}\)) at 30, 60 and 90 days after sowing respectively and were statistically comparable with the nitrogen uptake of weeds (2.86, 3.09 and 1.97 kg ha\(^{-1}\)) recorded under pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\), which inturn were significantly superior to the rest of weed control treatments. However, at 90 days after sowing the performance of pre-emergence application of alachlor @ 2.0 kg a.i.ha\(^{-1}\) was statistically alike with the performance of combined application of butachlor @ 1.5 kg a.i.ha\(^{-1}\), as pre-emergence and quizalofop-ethyl @ 100mlha\(^{-1}\), as post emergence in respect of nitrogen depletion by weeds. Highest uptake of nitrogen by weeds were recorded in weedy check (6.54, 8.64 and 6.53 kg ha\(^{-1}\)) at the respective stages (30, to and 90 days after sowing).

Interaction effect of cropping system and weed management treatments significantly influenced the nitrogen uptake by weeds at 60 and 90 days after sowing.

At 60 days, maize + soybean intercropping system recorded the lowest nitrogen uptake by weeds (1.88 kg ha\(^{-1}\)) after sowing being statistically at par with the nitrogen uptake of weeds of maize + ground nut intercropping system (2.26 kg ha\(^{-1}\)) and these two intercropping system performed equally well under weeding thrice (15, 30 and 45 days after sowing) pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) and alachlor @ 2.0 kg a.i.ha\(^{-1}\) registering the mean nitrogen uptake by weeds of 2.04, 2.49, 2.37 and 2.82 kg ha\(^{-1}\), respectively, which inturn were significantly superior to the rest of the treatment combinations. The performance of both the intercropping system i.e. Maize + soybean and maize + groundnut were statistically comparable under the weed control treatments of weeding thrice (15, 30 and 45 days after sowing), pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) and alachlor 2.0 kga.i.ha\(^{-1}\) (table 4.24.1)

Similarly at 90 days the same trend was observed in respect of mean nitrogen uptake by weeds. That means both intercropping systems i.e. maize
+ soybean and maize + groundnut performed equally well (statistically comparable performance) under the weed control treatments of weeding thrice, pre-emergence application of oxyfluorfen and alachlor at the respective stage and recommended doses, respectively (table 4.24.2).

4.6.2.2 Phosphorus

Mean data on uptake of phosphorus by weeds at different days after sowing (30, 60 and 90) as influenced by cropping systems and weed management treatments have been given in table 4.25.

The analysed data indicated that the effect of cropping system and weed management practices along with their interaction effect on mean uptake of phosphorus by weeds were statistically significant at all the respective stages.

Different cropping system significantly influenced the phosphorus uptake by weeds at 30, 60, and 90 days after sowing. Maize + soybean intercropping system allowed minimum uptake of phosphorus by weeds (0.79, 0.85 and 0.6 kg ha\(^{-1}\)) at 30, 60 and 90 days after sowing and were statistically comparable with maize + groundnut intercropping systems (1.03, 1.10 and 1.03 kg ha\(^{-1}\)) at the respective stages i.e. 30, 60 and 90 days after sowing. These intercropping systems also showed their superiority over pure stands of maize, soybean and groundnut at their respective stages of growth.

Among sole cropping, soybean being statistically at par with groundnut recorded significantly lower uptake of phosphorus by weeds. Maximum nutrient in this regard was depleted by weeds under sole cropping of maize at their respective stages of crop growth (30, 60 and 90 days after sowing).

All the weed management practices significantly reduced the phosphorus uptake by weeds as compared to weedy check at different days after sowing (on 30, 60 and 90). Weeding thrice manually at 15, 30 and 45 day after sowing allowed minimum uptake of phosphorus by weeds (0.83,
0.93 and 0.98 kg ha\(^{-1}\)) at 30, 60, and 90 days after sowing and was comparable with the mean phosphorus uptake by weeds (0.93, 1.02 and 1.04 kg ha\(^{-1}\)) from the plots treated with pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) at the respective stages and inturn were significantly superior to the rest of the weed control treatments. All the weed control treatments were significantly superior to the weedy check. Maximum depletion of nutrient phosphorus was recorded under weedy check, where no weed control measure applied.

Interaction effect of cropping systems and weed control treatments significantly influenced the mean phosphorus uptake by weeds at 30, 60 and 90 days after sowing.

Maize + soybean inter cropping system recorded the lowest phosphorus uptake by weeds under weeding thrice (15, 30 and 45 DAS) and was statistically at par with the weed control treatments of pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) at all the respective stages of growth. These treatment combinations inturn were statistically comparable with the maize + groundnut intercropping system under weeding thrice (15, 30 and 45 days after sowing) and pre-emergence application of oxyfluorfen @ 0.2 kg.a.i.ha\(^{-1}\) and was significantly superior to rest of the treatment combinations at all the respective stages of crop growth.

Maize + soybean and maize + groundnut intercropping system performed equally well under the weed control treatments of weeding thrice (15, 30 and 45 days after sowing) and pre-emergence application of oxyfluorfen @ 0.2 kg.a.i.ha\(^{-1}\) at all the stages of growth (30, 60 and 90 days after sowing) (table 4.25.1, 4.25.2 and 4.25.3).

**4.6.2.3 Potassium**

Mean data on potassium uptake by weeds at 30, 60 and 90 days after sowing as influenced by cropping system and weed management practices have been presented in table 4.26.
Pooled data (analysed) revealed that the effect due to cropping system and weed management practices along with their interaction effect on potassium uptake by weeds were statistically significant at all the three stages of crop growth (30, 60 and 90 days after sowing).

Cropping system significantly affected the uptake of potassium by weeds at the respective stages of crop growth. Maize + soybean intercropping system significantly reduced the uptake of potassium by weeds at all the three stages i.e. 30, 60 and 90 days after sowing (3.10, 3.29 and 2.13 kg ha\(^{-1}\), respectively) and inturn were significantly superior to the rest of the cropping system except at 30 days where maize + soybean and maize + groundnut intercropping system were statistically at par in respect of potassium uptake of weeds. Among the sole cropping, maize in pure stand recorded maximum uptake of potassium by weeds at all the respective stages of crop growth. However at 90 days after sowing, uptake of potassium by weeds under sole cropping of maize, soybean and groundnut were statistically comparable.

Different weed management treatments significantly reduced the uptake of potassium by weeds compared to weedy check. Weeding thrice at 15, 30 and 45 days after sowing reduced the depletion of potassium by weeds at 30, 60 and 90 days after sowing (3.01, 3.31 and 2.97 kg ha\(^{-1}\), respectively) and was statistically at par with the potassium uptake by weeds under pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) at 60 and 90 days after sowing, (3.58 and 3.09 kg ha\(^{-1}\)) while at 30 days weeding thrice was significantly superior to oxyfluorfen and these inturn were significantly superior to the rest of the weed control treatments. Highest depletion of potassium by weeds were recorded under weedy check at all the respective stages of crop growth.

Interaction effect of cropping system and weed management practices also significantly influenced the potassium uptake by weeds at all the three stages of crop growth (30, 60 and 90 days after sowing).
Maize + soybean intercropping system being statistically at par with maize + groundnut intercropping system registered lowest uptake of potassium by weeds under weeding thrice at 15, 30 and 45 days after sowing and pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) at all the three stages of crop growth at 30, 60 and 90 days after sowing. However at 60 and 90 says after sowing both the intercropping system perform equally well under pre-emergence application of @ 0.20 kg a.i.ha\(^{-1}\), performance of both intercropping system was statistically comparable with weeding thrice, pre-emergence application of oxyfluorfen and alachlor with the recommended doses at 60 and 90 says after sowing.

4.7 AVAILABLE SOIL N, P AND K AFTER HARVEST

The data on available soil, phosphorus and potassium at harvest of two years experimentations as influenced by cropping system and weed management practices have been presented in table 4.27.

4.7.1 Nitrogen

Available soil nitrogen was influenced by the different cropping system. Pure stand of soybean recorded maximum available soil nitrogen (265.4 kg ha\(^{-1}\)) followed by sole cropping of groundnut (261.0 kg ha\(^{-1}\)). Intercropping of maize with groundnut (256.8 kg ha\(^{-1}\)) proved inferior to the maize + soybean intercropping (259.0 kg ha\(^{-1}\)) in this regard. However, lowest available soil nitrogen (252.6 kg ha\(^{-1}\)) was recorded from the plots of pure stand maize.

Weed management measures increased the available soil nitrogen as compared with the weedy check. Plots weeded thrice (15, 30 and 45 DAS) recorded maximum available soil nitrogen (265.4 kg ha\(^{-1}\)) followed by pre-emergence application of oxyfluorfen @ 0.2 a.i.ha\(^{-1}\) (261.6 kg ha\(^{-1}\), alachlor @ 2.0 kg a.i.ha\(^{-1}\) (259.0 kg ha\(^{-1}\)) and combined application of butachlor @ 1.5 kg a.i.ha\(^{-1}\), as pre-emergence and quizalofop-ethyl @ 100 ml a.i.ha\(^{-1}\) as post emergence (256.0 kg ha\(^{-1}\)).
4.7.2 Phosphorus

Cropping system influenced the available soil phosphorus. Maximum value of available soil phosphorus was recorded in pure stand of soybean (20.80 kg ha\(^{-1}\)) followed by the sole cropping of groundnut (20.28 kg ha\(^{-1}\)), maize + soybean and maize + groundnut registering the value of 20.26 for both the intercropping system.

Weed management practices also influenced the available soil phosphorus. Plots weeded thrice manually at 15, 30 and 45 days after sowing recorded maximum quantity of available soil phosphorus (21.42 kg ha\(^{-1}\)) followed by pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) (20.86 kg ha\(^{-1}\)) and alachlor @ 2.0 kg a.i.ha\(^{-1}\) (20.12 kg ha\(^{-1}\)) along with combined application of butachlor @ 1.5 kg a.i.ha\(^{-1}\) as pre-emergence and quizalofop-ethyl @ 100 ml ha\(^{-1}\) as post emergence application. Lowest available soil phosphorus (19.08 kg ha\(^{-1}\)) was recorded from the plots of the unweeded check.

4.7.3 Potassium

Cropping system influenced the available soil potassium. However, the plots of pure stand of soybean recorded maximum available soil potassium (194.78 kg ha\(^{-1}\)) followed by pure crop of groundnut (193.28 kg ha\(^{-1}\)) and maize + soybean intercropping system (192.10 kg ha\(^{-1}\)). The lowest available soil phosphorus was recorded from the plots under maize + groundnut intercropping system (188.06 kg ha\(^{-1}\)).

All the weed management treatments influenced the available soil potassium. Plots weeded thrice at 15, 30 and 45 days after sowing recorded maximum value of available soil potassium (194.40 kg ha\(^{-1}\)) followed by pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha\(^{-1}\) (193.10 kg ha\(^{-1}\)), alachlor @ 2.0 kg a.i.ha\(^{-1}\), as pre-emergence (191.70 kg ha\(^{-1}\)) and combined application of butachlor @ 1.5 kg a.i.ha\(^{-1}\), pre-emergence + quizalofopethyl @
100 ml ha⁻¹, as post + emergence. However, the lowest available soil potassium was recorded from the plots of weedy check (189.76 kg ha⁻¹).

### 4.8 ECONOMIC ADVANTAGE

The mean data on gross return, net return and benefit: cost ratio as influenced by cropping system and weed management have been presented in table 4.28.

#### 4.8.1 Gross return

Mean data revealed that the highest gross return of Rs.36,277.6 ha⁻¹ was obtained from maize + groundnut intercropping system closely followed by maize + soybean intercropping system registering the mean gross return of Rs.35,189.6 ha⁻¹. Among sole cropping, maize gave highest mean gross return of Rs.21,849.6 ha⁻¹ followed by sole groundnut (Rs.20,922.0 ha⁻¹) and sole soybean (Rs.19,128.0 ha⁻¹). It was also observed that intercropping system recorded higher gross return than that of pure stand crops.

Among different weed control treatments, weeding thrice at 15, 30 and 45 days after sowing recorded the highest mean gross return of Rs.31,538.6 ha⁻¹ closely followed by the mean gross return obtained under pre-emergence application @ 0.20 kg a.i.ha⁻¹ (Rs.30,317.4 ha⁻¹).

All the weed management practices proved their superiority over weedy check in respect of mean gross return (table 4.28)

#### 4.8.2 Net return

Analysed mean data on net return revealed that the effect due to cropping system and weed management practice were found to be statistically significant. Whereas their interaction effect was non-significant.

Cropping system significantly influenced the mean net return. The highest mean net return of Rs.21360 ha⁻¹ was recorded from maize + ground
intercropping system and was statistically at par with mean value of net return (Rs.20, 180.60 ha$^{-1}$) obtained from maize + soybean intercropping system which in turn were significantly superior to the rest of the cropping system. Intercropping system proved significantly superior to pure stand of maize, soybean and groundnut.

Among weed management treatments, pre-emergence application of oxyfluorfen @ 0.2 kg a.i.ha$^{-1}$ recorded the highest mean net return of Rs17862 ha$^{-1}$ and was significantly superior to the rest of the weed control treatments. The next best performance in this regard was observed under pre-emergence application of alachlor @ 2.0 kg a.i.ha$^{-1}$ registering the mean value of net return of Rs.16469.60 ha$^{-1}$ followed by combined application of butachlor @ 1.5 kg a.i.ha$^{-1}$ as pre-emergence and quizalofop-ethyl @ 100 ml ha$^{-1}$ as post-emergence (Rs.10013.20 ha$^{-1}$). The significantly lowest mean value of net return was given by weedy check (Rs.7713.00 ha$^{-1}$). All the weed management treatments were significantly superior in respect of mean net return to weedy check. (table 4.28).

**4.8.3 Benefit: Cost ratio**

Mean data on benefit: Cost ratio as influenced by cropping system and weed management treatments have been found statistically significant whereas their interaction was found to be non-significant.

Among cropping system maize + groundnut intercropping recorded highest benefit: cost ratio (2.43) and was statistically comparable with the mean value of benefit: cost ratio (2.34) obtained under maize + soybean intercropping system. Which in turn were significantly superior to the rest of the cropping system. Among sole cropping groundnut recorded higher benefit: cost ratio (1.81) closely followed by sole maize (1.78) and was statistically at par in mean value of benefit: cost ratio of soybean.
Benefit: cost ratio was also significantly influenced by weed control treatments. Pre- emergence application of oxyfluorfen @ 0.2 kg a.i. ha\(^{-1}\) recorded maximum benefit: cost ratio (2.38) and was statistically at par with the mean value of benefit: cost ratio (2.29) obtained from pre-emergence application of alachlor 2.0 kg a.i. ha\(^{-1}\).