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EVALUATION OF DIFFERENT INTERCROPS FOR WEED MANAGEMENT AND ECONOMIC RETURNS IN MAIZE

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ABSTRACT

A research was conducted to determine the effect of different intercrops in maize at New Developmental Farm, The University of Agriculture Peshawar in summer during 2011. The experiment consisted of completely randomize design having three replications. There were five treatments in each replication and each treatment comprised of four rows, 0.75m apart with plant to plant distance of 20 cm, 4m long. The treatment consisted of maize + sunflower, maize + okra, maize + cowpea, maize + cucumber and maize sole. The results showed that highest weed frequency was recorded for Cyperus rotundus (75.43 %) while lowest weed frequency was recorded for Convolvulus arvensis (4.31 %). Furthermore, highest fresh and dry weed biomass was recorded for maize sole while lowest was recorded for maize + cucumber. Similarly highest plant height was recorded for maize sole (195.93 cm); whereas, shorter plant height was recorded for maize + sunflower (156.17 cm). Highest biological yield was recorded for maize sole and lowest biological yield was recorded for maize + sunflower. Maximum LER was recorded for maize + okra (1.79) and minimum LER value was recorded for maize + sunflower (1.45). In conclusion the results of the experiment showed that intercropping is much more economical as compared to sole cropping of maize. Thus in light of the experimental results it is recommended to use okra or cucumber as intercrop instead of sole maize.

Key words: Intercropping, maize, sunflower and weed.

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INTRODUCTION

Maize being an important cereal crop stood third after wheat and rice in world. It is dual purpose crop and well acknowledged in agro industries for commercial products. Maize kernels contain about

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starch, protein, oil, fiber, sugar, and ash at percentage of. 72, 10, 4.8, 9.5, 3 and 1.7, respectively (Chaudhary, 1993). Due to severe increase in world population demand for food increased to an extraordinary level as a result present system of monocropping, which does not meet the expanding needs of our small farmers from the decreasing supply of lands for cultivation and other limited resources (Saleem *et al*., 2000). These situations require a shift from monocropping to inter cropping, which is to be considered a good strategy for captivating excess labor, increasing land use efficiency, increasing production and income per unit time and area (Saleem *et al*., 2000). Furthermore, intercropping is much more advantageous as compared to sole cropping in response to yield (Willey, 1979). Contributors to yield advantages include; better use of growth resources (Trenbath, 1986). Intercropping also improves and maintains fertility of soil. (Patra *et al.,* 1986), increasing efficiency of nutrients use. Intercropping of cereals with legumes played significant role in increasing production in developed and under developing countries under limited water resources (Tsubo *et al*., 2005). Cowpea [*Vigna unguiculata* (L.) Walp] is an important leguminous crop and is usually intercropped with maize in the semi-arid regions of the tropics (Singh *et al*., 2003). It is also used for dual purpose as food and animal feed as well as increases soil fertility thus becoming valuable in the areas where land use has become intensified as it is creeping plant it covers the soil and suppress weed growth (Singh *et al*., 2003). Cucumber and okra are two important summer vegetables grown for food purpose. These can also be grown as inter crop with maize and provide benefit to low land farmers to take more crops at the same time with maize having more row to row distance (Norman, 1973). Maize and sunflower can also be used as inter crop and is helpful in suppressing weeds as both of these crops have different capability to capture nutrients and utilize them more efficiently (Willey, 1979; Jannasch and Martin, 1999; Li *et al*., 1999).

Inter crops not only facilitate farmer's having more crops at end but also helps to suppress weeds. Among the various reasons for low production in maize crop common problems are high weed infestation, improper planting methods and poor weed management practices. Weeds causes 25 to 80% yield reduction in maize (Ford and Pleasant, 1994; Chikoye and Ekeleme, 2003). Keeping in view the benefits of intercropping and losses caused by weeds in maize crop present research was designed to examine the compatibility of different inter crops with maize crop in agro-ecological conditions of Khyber Pakhtunkhwa.

MATERIALS AND METHODS

An experiment was conducted at New Developmental Farm, The University of Agriculture Peshawar during summer 2011. The experiment consisted of completely randomize design having three replications. There were five treatments in each replication and each treatment comprised of four rows, 0.75m apart with plant to plant distance of 20 cm, 4m long. The seed of local recommended maize variety (Azam) was sown in June 2011 with the help of dibbler and then thinned at 3 weeks after emergence to adjust the recommended number of plants per hectare. Intercrops was planted simultaneously with a ratio of (1:1) between each row of maize The recommended dose of nitrogen and phosphorus that was 150 kg ha^{-1} N and 60 kg ha^{-1} P. The whole dose of phosphorus along with half of nitrogen fertilizer in the form of single DAP and Urea, respectively, were applied at sowing by broadcasting and subsequent amount of nitrogen fertilizer was applied when it reached to knee height and tasseling stage of the crop. The intercropping systems comprised of Maize + sunflower, maize + okra, maize + cowpea, maize + cucumber and maize sole. Data was recorded on following parameters. Weed frequency (%), fresh weed biomass (kg ha^{-1}) and dry weed biomass (kg ha^{-1}), plant height (cm), biological yield (kg ha^{-1}) and land equivalent ratio.

RESULTS AND DISCUSSION

Weed frequency (%)

Data regarding weed frequency (%) are shown in Table-1. The table revealed that maize intercropping with sunflower, cucumber, okra and cowpea significantly affected weed frequency (%). The data table showed that highest weed frequency were recorded for *Cyperus rotundus* (75.43 %) followed by *Digera arvense* (61.33 %), *Euphorbia prostata* (59.10 %), *Trianthema portulacastrum* (43.71 %), *Ecchinochloa crussgali* (30.85 %), *Dicanthium annulatum* (28.91 %), while lowest weed frequency was recorded for *Convolvulus arvensis* (4.31 %). Baumann *et al.* (2000) suggested that intercropping helps to improve weed suppression relative to monoculture

Fresh weed biomass (kg ha^{-1})

Analysis of the variance indicated that maize intercropped with sunflower, cucumber, okra and cowpea significantly affected fresh weed biomass (Table-2). The data showed that higher fresh weed biomass was recorded for sunflower sole (5863 kg ha^{-1}) followed by maize sole (5130 kg ha^{-1}), cowpea sole (4685.3 kg ha^{-1}) and okra sole (4240 kg ha^{-1}) while the lowest was recorded in cucumber sole (4027 kg ha^{-1}). Among the intercropping the lowest fresh weed biomass was recorded for maize + cucumber (2348.3 kg ha^{-1}) which was

statistically at par with maize + cowpea (2397.3 kg ha^{-1}), followed by maize + okra (3448.3 kg ha^{-1}) and maize + sunflower (4273.3 kg ha^{-1}). The reason for high fresh weed biomass in sole crop might be due to minimum competition and maximum resources availability to weeds while in intercrop the weeds were under stress resulted in low fresh weed biomass. These results are in great uniformity with the work reported by Mohandoss *et al*. (2002) who stated that intercropping reduced weed germination and biomass.

Dry weed biomass (kg ha^{-1})

Mean value of the data showed that maize intercropping with sunflower, cucumber, okra and cowpea significantly affected dry weed biomass (Table-2). The statistical analysis of the data table showed that higher dry weed biomass was recorded for sunflower sole (3012 kg ha^{-1}) whereas the lowest dry weed biomass (1900 kg ha^{-1}) was recorded for Maize + sunflower. Furthermore, among the intercropping maize+cucumber (1125 kg ha^{-1}) also resulted in minimum dry weed biomass as compared to other inter cropping i.e. maize+okra (1393 kg ha^{-1}), maize+cowpea (1637.7 kg ha^{-1}) and maize+sunflower(1900 kg ha^{-1}). These results are in great uniformity with the work reported by Hugar and Palled (2008) that intercropping of cowpea and French bean significantly reduced the weed population and weed dry biomass.

Plant height (cm)

Data regarding plant height (cm) is shown in Table-2. The analysis of variance showed that maize intercropping with sunflower, cucumber, okra and cowpea significantly affected plant height. The data table revealed that taller plant height was recorded for maize sole (195.93 cm) which is statistically at par with maize + cucumber (193 cm) whereas shorter plant height recorded for maize + sunflower (156.17 cm). Palaniappan (1985), Obasi (1989) and Olasantan (1992) reported that high plant height is the important feature to intercept more sunlight in intercropping system and showed the competitive ability of a plant for light. The reason for best plant height might be due to wider space, reduce competition for nutrients and sunlight which provide a good environment for a plant to grow taller. The result is in the line of Hugar and Palled (2008) who observed increased in plant height in maize sole crop.

Biological yield (kg ha^{-1})

Data regarding to biological yield is shown in Table-2. The statistical analysis of the data revealed that maize intercropping with sunflower, cucumber, okra and cowpea significantly affected maize biological yield. The mean data revealed that highest biological yield were recorded for maize sole (8671.7 kg ha^{-1}) followed by maize + cucumber (8192 kg ha^{-1}) and maize + okra (7563.7 kg ha^{-1}) while lowest biological yield was recorded for maize + sunflower (4812 kg

ha^{-1}). The reason for high biological yield in maize sole may be due low competition and more recourse availability, which increased the green area of the crop, thus there might be more photosynthesis processed which increased biological yield while in intercropped system may be due inter-specific competition caused less biological yield. The same result was also reported by Chianeh *et al*. (2011) that highest biological yield was recorded for maize sole as compared to intercropped maize.

Land Equivalent Ratio (LER)

The data in Table-3 showed that land equivalent ratio were greater in all intercropping treatments, which indicated yield benefit of intercropping over sole maize crop. Maximum LER was recorded for maize + okra (1.79), followed by maize + cucumber (1.50), maize + cowpea (1.48) while minimum LER value was recorded for maize + sunflower (1.45). According to Willey (1990) who observed that cereal crop intercropping with legume grain crops gave higher yields than sole crop as showed by LER values. Normally a legume i.e. cowpea has high LER but in our case okra has maximum LER value as compared to all other intercrops used n the research. The reason for high okra LER could be high price of okra price at present time.

Table-1. Weed frequency (%) of maize as affected by intercropping

Weed species	Weed frequency (%)
Trianthema portulacastrum L.	43.71
Cyperus rotundus L.	75.43
Euphorbia prostata Aiton.	59.10
Digera arvense Forsk.	61.33
Cynodon dactylon L.	25.66
Ecchinochloa crussgali (L.) Beauv.	30.85
Convolvulus arvensis L.	4.31
Dicanthium annulatum L.	28.91

Table-2. Fresh weed biomass (kg ha^{-1}) and dry weed biomass (kg ha^{-1}), plant height (cm) and biological yield (kg ha^{-1}) of maize as affected by intercropping

Treatments	Fresh weed biomass (kg ha^{-1})	Dry weed biomass (kg ha^{-1})	Plant height (cm)	Biological yield (kg ha^{-1})
Maize + sunflower	4273.3 d	1900.3 e	156.17 d	4812.0 e
Maize + cucumber	2348.3 e	1125.0 h	193.00 ab	8192.0 b
Maize + okra	3448.3 f	1393.0 g	185.80 bc	7563.7 c
Maize + cowpea	2397.3 e	1637.7 f	178.40 c	5855.3 d
Maize sole	5130.0 b	2731.3 b	195.93 a	8671.7 a

Cucumber sole	4027.0 de	2027.3 de	_	_
Okra sole	4240.0 d	2116.0 d	_	_
Cowpea sole	4685.3 c	2446.7 c	_	_
Sunflower sole	5863.0 a	3012.0 a	_	_
LSD	730.70	132.37	1.22	322.50

Means followed by different letters are significantly different at P≤0.05.

Table-3. Land equivalent ratio of maize intercropping with sunflower, cucumber, okra and cowpea.

Treatment	Maize	Intercrop	LER
Maize+sunflower	0.62	0.83	1.45
Maize+cucumber	0.97	0.53	1.50
Maize+okra	0.90	0.89	1.79
Maize+cowpea	0.74	0.74	1.48

CONCLUSION

Results of the present study revealed that intercropping significantly decreased fresh weed biomass and dry weed biomass. Intercropping of maize with cucumber, okra and cowpea significantly affected plant height and biological yield. However, highest LER was recorded for maize + okra and maize + cucumber while lowest LER was recorded for maize + sunflower. Sole cropping of maize might increase all the growth and yield related parameters but could not compensate the net income benefits or LER obtained from intercropping. In light of the above discussion it is recommended that maize should be intercropped with okra or cucumber to get higher economic returns as compared to sole cropping system.

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