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EFFECT OF ZERO TILLAGE AND HERBICIDES ON THE WEED DENSITY AND YIELD OF CHICKPEA UNDER RICE-BASED CONDITIONS OF D.I. KHAN

Gul Hassan[1], Naqibullah Khan[2] and Haroon Khan[1]

ABSTRACT

Zero tillage was compared with conventional tillage on gram in a rice-based system. Herbicidal treatments (pre- and post- emergence) were also included in the trial. The experiment was laid out in a triplicated split-plot arrangement in randomized complete block design. The tillage regimes were assigned to the main-plots and the herbicides Stomp 330 E and Puma Super along with a weedy check were kept into the sub-plots. Gram cultivar Karak-1 was sown on November 22, 2002 in a sub-plot size of 9x3 m2. Stomp 330E was applied as pre-emergence, soon after sowing, while the post-emergent Puma Super was sprayed on 07.01.2003. There were significant differences ($P<0.05$) in weed density for tillage operations and herbicides, while the interaction was non-significant. On average, the conventional tillage plots showed relatively lower weed infestation as compared to zero tillage. Both the pre-and post-em herbicides in the trial significantly decreased ($P<0.05$) the weed infestation as compared to weedy check. As a consequence of lesser weed competition, the higher seed yield was realized in the conventional tillage. Similarly, the herbicides out yielded the weedy check. The Stomp 330E surpassed Puma Super by producing 2002 as compared to 1822 kg ha^{-1} in the later herbicide. Further studies are suggested to confirm these findings.

Key Words: No till, Zero tillage, gram, herbicides, weed density, yield, fleabane

INTRODUCTION

Pulses are the important constituents of the human diets in South Asia. Chickpea; the crown of pulses, is consumed in a variety of diets like dal, bread, picoras and kebabs etc. It is also cooked as a delicious pot herb like spinach. Chickpea is grown in tropical, subtropical and temperate regions of the world. Kabuli type is grown in temperate regions, while Desi type is grown in the semi arid tropics (Muehlbaeur and Singh, 1987). Kabuli type chickpea has larger seeds and yields more under irrigated conditions, while Desi type has small seeds, but yield typically is higher under Indian sub-continental conditions. Optimum diurnal temperature regimes for chickpea production include 18-26°C day and 21-29°C night and the optimum annual rainfall is 600-1000 mm (Duke 1981; Muehlbauer *et al.*, 1987; Smithson *et al.*, 1985). India being the leader in production by producing 80-90% of the world's gram. The other nations producing chickpea include Pakistan, Middle East and California, Idaho, Washington, and Montana States of U.S.A. The protein rich chickpea contains 25-29% protein, 38-59%

1 Department of Weed Science, NWFP Agricultural University, Peshawar 25130– Pakistan
E-mail: hassanpk_2000pk@yahoo.com.

2 Agricultural Research Institute, Dera Ismail Khan - Pakistan.

carbohydrate, 3% fiber and 5-6% oil (Hulse, 1991). During 2000-01, chickpea was grown in Pakistan on 905 thousand ha, while in NWFP, it was grown on 62.1 thousand ha with a production of 397 and 10.8 thousand tons, respectively (Anonymous, 2002b). The deep rooting habit and consequent tolerance to water stress of chickpea makes it a winner under the drought prone areas of NWFP like Lakki Marwat, Karak and D.I.Khan districts. In Pakistan, chickpea is grown under three cropping systems. the rainfed system, constituting 88% of the total chickpea area, where chickpea is grown as a sole crops or intercrop. In the rice-based system, constituting 11% of the total area, where the crop is grown on residual moisture after rice. The irrigated system, constituting only 1% of the total area. In D.I.Khan the gram is either grown on the residual moisture of rice or under rainfed/rod-kohi conditions. Despite the immense importance of the chickpea in the economy of the country in general and the chickpea producing districts in particular, and the role of weed competition in chickpea, no attention has been paid by the scientists and extension specialists to boost the yields through effective management of weeds.

Zero tillage advocated worldwide for its merits (Khan, 2001), is practiced in chickpea cultivation since centuries in rainfed areas of Bhakkar, Mianwali, Jhang, Lakki Marwat and Karak. Wild onion (*Asphodelus tenuifolius*) and *Carthamus oxycantha* are a serious problem in chickpea in these areas. But, in rice-based system of D.I.Khan, littleseed canary grass (*Phalaris minor*), common vetch (*Vicia sativa*), meadow peavine (*Lathyrus aphaca*) and grass peavine *(L. sativus)* are the problem weeds. Zero tillage in rice-based system will not only enable the earlier planting of gram, reduce the land preparation cost, avert the water logging by just utilizing the residual moisture, but also it will let the weeds stay dormant below the soil for their lack of exposure to light. It is very astonishing that despite the maintenance of flood to a level of more than 4 inches throughout the rice-growing season, the annual weeds subsequently infest the succeeding crops like wheat and gram in higher intensity, although with an altered composition. There are several features, which render the weed species successful including enormous seed production, early rapid growth and space capture etc. but still is another attribute which confers success to weeds which is dormancy or rest period, which enables the seeds to persist in the soil and survive under the conditions not suitable for plant growth (Karssen, 1982). Dormancy is the arrest in development of reproductive propgules when environmental conditions (warm temperature, adequate moisture and O_2) are suitable for growth (Harper, 1977; Holt, 1987) in other non-dormant tissues. Thus, dormant tissues will not germinate and the dormant buds or spores will not sprout even though the environmental conditions are favorable for their growth. Dormancy and irregular germination of weed seeds are responsible for a major part of the difficulty and expense of weed control. Numerous investigations spread over many years have studied basic and practical aspects of the problem. The factors responsible for dormancy are either innate or environmental (Radosevich and Holt, 1984). Harper (1957; 1977) suggests that some seeds are born dormant (innate), some achieve dormancy (induced) and some have dormancy thrust upon them (enforced or quiescence). Popay and Roberts (1970) and Benvenuti and Macchia (1995) showed that the high CO_2 and low O_2 (hypoxia) induced dormancy while Taylorson (1970) reported otherwise. The studies of Holm (1972) showed that as decreased O_2 in the soil microenvironment accumulated acetaldehyde, ethanol and acetone. Several studies exhibit that the buried seeds of annual weeds undergo dormancy-non-dormancy cycles and even light does not stimulate germination (Karssen, 1970; Schafer and Chilcote, 1970; Taylorson, 1970). Baskin and Baskin (1985) and Benvenuti and Macchia (1994) have further added that dormancy-non-dormancy transition may be related to changes in membrane properties. Carmona and Murdoch (1996) deciphered the differential response of temperature on *Chenopodium album*,

Rumex crispus and *Avena fatua* seeds. Caudra *et al.*, (1996) reported increased germination in GA_3 incubated seeds. Vaishya et al. (1996) reported 41.7% losses in chickpea due to weed competition. In the subsequent studies, Vaishya *et al.*, 1999 reported 41-44 % losses to chickpea by weeds. Hassan and Marwat (2001) evaluated the losses to gram crop due to weeds to the tune of about Rs. 5 billion and 164 million, respectively at the national and NWFP level. In D.I.Khan, best control of chickpea weeds was achieved with the application of pendimethalin and trifluralin (Hassan *et al.*, 1995). While the findings of Ahmad et al. (1990) endorse the pendimathalin, oxadiazon and metribubuzin +MCPA, for control of chickpea weeds. The worst chickpea weed of D.I.Khan; meadow peavine (*L. aphaca*) alongwith common lambsquarters and fumitory was controlled by trifluralin, pendimathalin and metribuzin (Balyan and Malik, 1996). Application of 1.5 kg thiobencarb ha^{-1} alone and in combination with 2,4-D (1.0 + 0.5 kg ha^{-1}) in rice, 1.0 kg pendimethalin ha^{-1} in *Cicer arietinum* was the best treatment in rice-gram cropping system (Singh and Singh, 1998).

Material And Methods

An experiment was conducted at Agricultural Research Institute, Dera Ismail Khan during 2002-3 to investigate the effect of zero tillage and herbicides on the weed density and yield of chickpea under rice-based cropping system. The experiment was laid out in a triplicated split-plot arrangement in a randomized complete block design. The tillage regimes were assigned to the main-plots and the herbicides Stomp 330 E and Puma Super along with a weedy check were kept into the sub-plots. Gram cultivar Karak-1 was sown on November 22, 2002 in a sub-plot size of 9x3 m^2. Fertilizer was applied @ 20-40-40 NPK kg ha^{-1}. All the fertilizers were incorporated in soil before sowing. Agronomic practices were equally adopted. The pre-emergence herbicide was sprayed just after sowing, while the post-emergence herbicides were sprayed on 07.01.2003 for grassy weeds only. During the course of studies the data were recorded on weed density (m^{-2}) one month after treatment with herbicides and at the time of harvesting and grain yield (kg ha^{-1}) of chickpea. Standard procedures were adopted for recording the data on above parameters. The data recorded for each parameter were individually subjected to the ANOVA technique by using MSTATC Computer Software Package and the significant means were separated by using Fisher's protected LSD test (Steel and Torrie, 1980).

Results And Discussion

An experiment comprising tillage regimes and herbicides on chickpea was carried out at Agricultural Research Institute, Dera Ismail Khan. Data were recorded on weed density (m^{-2}) and seed yield (kg ha^{-1}) of chickpea. The data are presented as under:

Weed Density (m^{-2})

There were significant differences ($P<0.05$) in weed density for tillage operations and herbicides, while the interaction was non-significant (Table 1). On average, the tillage plots relatively showed lower weed flora as compared to zero tillage. Both the pre-and post-emergence herbicides in the trial have shown significant decrease ($P<0.05$) in weed infestation against weedy check, although the per-emergence has shown better weed control. These findings are in a great analogy with the work reported by Hassan *et. al.*, 1995, Ahmad *et al.*, 1990, Balyan and Malik, 1996 and Sigh and Singh, 1998 who reported the efficiency of pendimethaline in controlling chickpea weeds. The weed density data recorded at the time of harvesting showed the preponderance of *Conyza stricta* (fleabane), which commonly is not the weed competitive in chickpea and other rabi crops.

Table-1. Effect of tillage methods and herbicides on weed density (m^{-2}) in chickpea

Herbicide	Conventional Tillage	Zero tillage	Herbicide Means
Stomp 330 E	2.67	2.33	2.50 b
Puma Super	2.67	3.67	3.17 b
Weedy Check	9.00	11.33	10.17a
Tillage Means	4.78 b	5.78 a	

Means sharing a letter in common in the respective category do not significantly differ at $P<0.05$.

The data in Table-2 exhibits that the *Conyza* density was only significant between the tillage regimes, whereas the differences between the herbicides and the interaction of herbicides with the tillage practices were non-significant statistically. As the herbicides applied were effectively post emergently, the *C. stircta* germinating during early March was not influenced by the herbicides. The abundant growth of the referred weed is attributable to the deposit of water borne seed in rice which stayed undisturbed in the no tillage, while in the conventional tillage, the stirring by filed implements damaged the seeds either by injury or burying deep.

Table-2. Effect of tillage methods and herbicides on *Conyza stricta* (fleabane) density (m^{-2}) in chickpea

Herbicide	Conventional Tillage	Zero tillage	Herbicide Means
Stomp 330 E	0.00	16.00	8.00
Puma Super	0.00	17.00	8.50
Weedy Check	0.00	17.67	8.83
Tillage Means	0.00 b	16.89 a	

Means sharing a letter in common in the respective category do not significantly differ at $P<0.05$.

Grain yield (kg ha^{-1})

Data on grain yield (kg ha^{-1}) [Table 3] showed that there were significant differences for tillage practices and weed control treatments, while their interaction was non-significant ($P>0.05$). On average, the higher grain yield was recorded in tillage plots as compared to zero tillage. In case of chemical weed control treatments, on average the plots receiving Stomp 330 E out-yielded the Puma super. The weedy check however, showed the lowest yield under both tillage regimes. The interaction of herbicides with the herbicides exhibited that highest numerical yield of 2095 kg ha^{-1} was harvested under the conventional tillage treated with Stomp 330E. It was followed by the zero tillage under the same herbicide (1910 kg ha^{-1}). The lowest yield (1534 kg ha^{-1}) was realized in zero tillage and the weedy check (Table-3). Under the tilled and no tilled plots, there is a difference of 162 kg ha^{-1}, which could easily be nullified with the land preparation cost. If the

environmental benefits were included then the zero tillage is better than the conventional tillage, thus it is advocated for wheat in the rice-based cropping system of D.I.Khan These Vaishya *et al.*, (1996) and Vaishya *et al.*, 1999 who reported upto 44% losses in chickpea due to weed competition. The dormancy of seed as reported by Popay and Roberts (1970), Benvenuti and Macchia (1995) and Holm (1972) due to high CO_2 and low O_2 (hypoxia) could not be ascertained under the zero tillage whereas Karssen, 1970; Schafer and Chilcote, 1970; Taylorson, 1970 exhibit that the buried seeds of annual weeds undergo dormancy-non-dormancy cycles and even light does not stimulate germination.

Table-3. Effect of Tillage methods and herbicides on the Yield (kg ha^{-1}) of chickpea

Herbicide	Conventional Tillage	Zero tillage	Herbicide Means
Stomp 330 E	2095	1910	2002 a
Puma Super	1905	1738	1822 b
Weedy Check	1666	1534	1600 c
Tillage Means	1889 a	1727 b	

Means sharing a letter in common do not significantly differ at P<0.05.

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