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Effect of different Weed Management Practices on Weed Dry Matter Accumulation and Weed Population in Chickpea *(Cicer arietinum L.)* and Lentil (*Lens culinaris L.*) Intercropping System

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A B S T R A C T

A field experiment was conducted in Lovely Professional University during the winter (Rabi) season of 2019-2020 at Phagwara, Punjab to determine the weed control efficiency of different herbicides on chickpea intercropping with lentil. By using different weed management practices in chickpea and lentil with different doses of herbicides viz. T1: Pendimethalin @ 0.75kg/ha at 2 DAS, T2: Fluazifop-p-butyl @ 0.5 kg/ha at 30 DAS, T3: Metribuzin @ 1.0kg/ha at 2 DAS, T4: Imazethapyr @ 0.75kg/ha at 30 DAS, T5: Isoproturon 1.0kg/ha at 30 DAS, T6: Hand weeding at 30 DAS, T7: Hand weeding at 30, 60 DAS, T8: Weedy free, T9: Weedy check data were evaluated in randomized block design with three replication under irrigated conditions. Due to weed competition, the yield of chickpea and lentil were reduced. These weed management practices help to increase the yield of chickpea intercropping with lentil. This study was taken to know the weed control efficiency of herbicides in chickpea intercropping with lentil. The weed competition was highest during 30 DAS and the maximum weed density was found in 60 and 90 DAS. Weed species were recorded such as broadleaf weeds like *Coronopus didymus*, *Chenopodium album*, *Melilotus officinalis*, *Phalaris minor*, etc. The main focus of this experiment was to study dry matter accumulation by weeds at different days after sowing (30, 60, 90, and 120).

Keywords

Accumulation, Chickpea, Efficiency, Herbicides, Weed competition, etc

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Introduction

Chickpea (*Cicer arietinum L.*) is the most extensively cultivated pulse crop in India with an area of approximately 12.03 million hectares adding 9.24 million tonnes of grain yield annually to the world food economy with average productivity of 78 kg/ha. According to (Ministry of Agriculture) reported that the leading pulse crop among all the pulses is chickpea grown in an area of 8.3 million hectares with an annual production of 7.7 million tonnes, although the average productivity was recorded about 928 kg/ha. According to (Chand *et al.*, 2010) reported that among the pulse crops of India chickpea

sharing 29.7 and 38% of the total area and production among all the pulse crops respectively. But due to weed infestation, the yield of chickpea also reduces. According to (Gupta et. al. 2012) said that it is important to use effective weed control practices to reduce the loss of yield. According to (Ali and Kumar, 2005) reported that chickpea plays an essential role in sustaining soil productivity by enhancing their physical, chemical, and biological properties and entrap atmospheric nitrogen in their root nodules. This fixed nitrogen helps in the succeeding crops. Chickpea is rich in proteins, carbohydrates because of these nutritional values chickpea grown all over the world not only in India. Chickpea has many nutritive values Protein (18-20%), Carbohydrate (61-62%), Fat (4.5%), Calcium (280 MG/100g), Phosphorus (301 mg/ 100g) and Iron (12.3 mg/100 g). (Phogat *et al.,* 2003) demonstrated that the yield of lentils reduces due to weeds up to 73%. There are various obstacles such as discarded soil, lack of improved varieties, poor fertilization; diseases; insect & pest attack, and poor weed management practices which lead to reducing the yield of lentils and chickpea. In the global production of lentils, Turkey ranks third in position following by India and Canada (FAO, 2014).

Red lentils were grown in Turkey on an area of 214.788 hectares with 410.000 tons a year production (TUK, 2014). (Sharma, 2009; Kumar, 2010) examined that poor productivity of chickpea and lentil is mainly due to the higher weed competition. It is reported that most of the weed species grown faster than the main crop plant and inhibit the growth of the main crop. Weed competes for crop plant for light, nutrient, space, etc. Because of higher weed competition, it reduces the yield of chickpea and lentil crops up to 75% (Balyan and Bhan, 1984). According to (FAOSTAT 2008), examined that among legumes grain lentil ranks sixth in production after chickpea, faba bean, dry beans, pea, and cowpea, and (Sarker and Erskine 2006), suggested that the oldest domesticated plants are known as humanity. Weed species found in chickpea and lentil crop viz, *Melilotus officinalis, Coronopus didymus, Medicago denticulata, Phalaris minor, Rumex dentatus, Anagallis arvensis, Chenopodium album,* etc. According to (Saxena, 1987) demonstrated that in winter-sown chickpea and lentil pulse crop weeds are a serious problem to many farmers because of lack of knowledge to use herbicides at right time and having lack of suitable management practices to reduce the population of weeds of winter sowing the crop should be planted at the high-density population, the early stage of growth, which makes inter-row cultivation impossible. Therefore, it is reported that Pendimethalin and Metribuzin were effectively controlled the broadleaf weeds such as Chenopodium album. Moreover, it not effective against many weeds such as *Melilotus* sp. and *Cyperus rotundus* (Kumar and Hazra, 2012). According to (Chaudhary *et al.,* 2011) reported that for effective weed control of Pendimethalin with hand weeding at 30, 60 DAS gives good results. For effective weed management use of pre-emergence herbicides along with post-emergence herbicides may be one of the best tools for controlling the broad-spectrum weed population in chickpea intercropping with lentil.

According to (Kumar *et al.,* 2013) observed that quizalofop ethyl is recommended in soybean crops and some other leguminous crops to restrict the growth of grassy weeds. Hand weeding is a traditional method of weed management but hand weeding doesn't control weeds during all the stages of the crop and this method is required more labor. By using herbicides in the combination of hand weeding leads to effective weed control in chickpea and lentil crops. These chemical methods also save the time of farmers.

Materials and Methods

A Field experiment was conducted during the winter (Rabi) season of 2019-2020 at Phagwara, Punjab to determine the weed control efficiency of different herbicides on chickpea intercropping with lentil. The area of the experiment is situated at a height of 234 meters (768 ft.) from mean sea level. Lovely Professional University lies in the Phagwara region of Punjab which is an area of the central plain zone and situated in the northeastern part of India. 5-7 degree Celsius minimum temperature recorded in winters and in summers the maximum temperature goes up to 40-48 degree Celsius. The average humidity in summers is 75-80%. The soil of this region is good infertility status and the soil of my experimental area is sandy loam in nature. As we know in the Punjab region tube well is used as the main source of irrigation.

By using different weed management practices in chickpea and lentils with different doses of herbicides viz. T1: Pendimethalin @ 0.75kg/ha at 2 DAS, T2: Fluazifop-p-butyl @ 0.5 kg/ha at 30 DAS, T3: Metribuzin @ 1.0kg/ha at 2 DAS, T4: Imazethapyr @ 0.75kg/ha at 30 DAS, T5: Isoproturon 1.0kg/ha at 30 DAS, T6: Hand weeding at 30 DAS, T7: Hand weeding at 30, 60 DAS, T8: Weedy free, T9: Weedy check data were evaluated in randomized block design with three replication. The Weed-free and weedy check plots were maintained for the calculation of weed control indices. Chickpea variety GPF-2 was used for the study. This variety was released by Punjab Agricultural University (PAU) in the year 1995 this variety is suitable for Punjab, Haryana, Delhi, North Rajasthan & West U.P states. The average yield of this variety is 21-23Q/ha and the days of maturity of this variety is 152 days. This variety is resistant to wilt & tolerant to ascochyta blight. The seed of this variety is yellowing brown. Lentil variety Pl-08 was used for the study. This variety was released from G.B. Pant University of Agriculture and Technology. The Plant-to-Plant and row-to-row distance were maintained 30×10 cm. Nitrogen 1.6 kg and 12.3 kg Phosphorus was applied in 500 m.sq. at the time of seedbed preparation as per the recommendation. For lentil 1.3 kg N, 6.0 kg P, 3 kg K was applied at the time of sowing. To ensure good germination of seeds field was prepared after irrigation before one week of sowing. Post-emergence herbicide was applied 25 DAS, whereas pre-emergence herbicides applied after 1-2 DAS. Other intercultural practices were followed as per the recommendations of crops. For the calculation of dry weight and weed population, an iron square of size 30 cm was used to make observations through random sampling in each plot at 30, 90, 60,120 DAS. The total number of weeds was counted species-wise from each plot separately and analyzed after observing the original data to square root transformation ($\sqrt{x+1}$). Similarly, for the dry weight of weeds, weeds were collected from each plot in 25cm quadrate and then taken the fresh weight of the samples after that put into the oven at 70 degree Celsius temperature for 72 hours, weighed (g/m.sq.). The dry weight of chickpea and lentil crops was evaluated by uprooting 5 plants randomly from each plot on different days after sowing.

Results and Discussion

Weed population

The common weeds present in the experimental site were viz. *Medicago denticulata, Anagallis arvensis, Coronopus didymus, Rumex dentatus, Phalaris minor, Chenopodium album, and Melilotus officinalis, Canada thistle, Malva parviflora*, etc. The most dominant weed in the experimental site was Coronopus didymus followed by Medicago denticulata followed by Chenopodium. In this study, we found that

broadleaf was dominant in the experimental site. Similarly, Weed population and weed dry matter was recorded in different weed management practices. However, the highest weed density was found in weedy check treatment. Weed population recorded at 30, 60, and 90 DAS and proved that different weed management treatments significantly reduce the weed population. All weed management practices considerably reduced the weed density as compared to weedy check (T9) followed with T1 (Pendimethalin @ 1.0 kg ha-1), which was at par with T5 (Isoproturon @ 1.0 kg ha-1), T3 (Metribuzin @1.0 kg ha-1). Out of all the treatments, T8 (Weed-free) was recorded considerably a minimum number of weeds per meter square over the other treatments at 30, 60 DAS. The maximum number of weeds was recorded under weedy check treatment (T9). At 30 DAS these all weed species were non-significant. *Medicago denticulata L.* found the most dominant weed in T1 (Pendimethalin @ 0.75 kg ha-1) followed with *Coronopus didymus L* followed by *Phalaris minor L.* However, significant variation in weed dry and weed density was recorded because of various weed management practices.

Weed dry matter

The dry matter accumulation of weeds denotes the competition offered by weeds species. The higher the dry matter accumulation by weeds during the crop growth development period, the higher the competition between weeds and crop plants. The yield reduction of crops directly related to the dry matter accumulation by the weeds or weed population. The data of dry matter accumulation were recorded on 30, 60, and 90 DAS, respectively. At 30 DAS weed, dry weight was not significant, at 60, 90 DAS dry weight of weeds increased. It indicates that higher weed dry weight took place up to 60 DAS to maturity of the crop. Singh and Singh (1992) also observed that the maximum dry matter accumulation was taking place during 60 DAS to harvest. The highest dry matter production was recorded in weedy check treatment (T9) at par T4, T2, and the lowest dry matter accumulation was found in weed-free treatment (T8).

Table.1 Active ingredient, trade name, formulation doses, and time of application of herbicides

Treatments	Active Ingredients	Trade Name	Formulations	Application Doses	Time of Application
T1	**Pendimethalin (30%)**	Stomp	EC	0.75	Pre emergence 1 DAS
T2	**Fluazifop-p-butyl (11.1%)**	Fusilade	SL	0.5	Post emergence 30DAS
T3	**Metribuzin (70%)**	Sencor	WP	1.0	Pre and post emergence
T4	**Imazethapyr (10%)**	Pursuit	SL	0.75	Post emergence 30 DAS
T5	**Isoproturon (75%)**	Arelon	WP	1.0	Post emergence 30 DAS
T6	**Hand weeding**	---	---	---	30 DAS
T7	**Hand weeding**	--	----	----	30, 60 DAS
T8	**Weed free**	---	---	---	---
T9	**Weedy check**	---	---	---	----

EC=Emulsifiable concentrate, **SL**= Soluble liquid, **WP**= Wettable Powder, **DAS**= Days after sowing

Table.2 Prominent weed species present in experimental field

Sr.No.	Botanical name	Common name	Local name(India)
1.	*Anagallis arvensis L.*	Billibooti	Krishanneel
2.	*Chenopodium album L.*	Lambsquarter	Bathua
3.	*Coronopus didymus L.*	Swine cress	Chatpata
4.	*Medicago denticulata L.*	Black medic	Maina
5.	*Melilotus alba L.*	White sweet clover	Senji
6.	*Rumex dentatus L.*	Sour dock	Jungli palak
7.	*Cannabis sativa L.*	Marijuana	Bhang
8.	*Phalaris minor L.*	Canary grass	Gullidanda

Table.3 Weed population under different herbicidal treatments at 60, 90 DAS in chickpea and lentil intercropping system

Treatments	*Medicago denticulate*	*Anagallis arvensis*	*Coronopus didymus*	*Rumex dentatus*	*Phalaris minor*	*Chenopodium album*	*Canada thistle*	*Malva parviflora*	*Melilotus officinalis*
Pendimethalin	1.93 (3.33)	1.57(1.6)	1.89(2.66)	1.58(1.66)	1.76(1.33)	1.17(0.66)	1.0	1.0	1.24(0.66)
Fluazifop-p-butyl	1.89(2.66)	1.30(1)	1.92(3)	1.58(1.6)	1.58(1.66)	1.58(2)	1.0	1.0	1.0
Metribuzin	1.64(2.33)	1.58(1.6)	1.55(1.33)	1.52(1)	1.55(1.33)	1.89(1.33)	1.13(0.8)	1.0	1.56(1.6)
Imazethapyr	1.92(3.33)	1.92(3)	1.55(1.3)	1.87(2.33)	1.58(1.66)	1.58(1.66)	1.0	1.0	1.28(0.8)
Isoproturon	1.58(2.33)	1.61(2)	1.89(2.6)	1.28(0.66)	1.61(2)	1.61(2)	1.0	1.0	1.0
Hand weeding (30 DAS)	1.89(2)	1.92(3)	1.87(2.33)	1.83(2)	1.87(2.33)	1.87(1.33)	1.0	1.24(0.6)	1.0
Hand weeding(30,60DAS)	1.99 (3.33)	1.33(1.3)	1.99(4)	1.28(0.66)	1.87(2.33)	1.87(1)	1.0	1.0	1.0
Weed free	1.16(2)	1.52(1)	1.89(1.33)	1.89(1)	1.55(1.33)	1.55(1.33)	1.0	1.0	1.0
Weedy check	2.07(5.66)	2.02(5)	2.07(5.6)	2.12(0.66)	1.95(5)	1.95(1)	1.57(1.7)	1.52(1.4)	2.007(3.03)
C.D at 5%	0.58	0.20	0.20	0.18	0.73	0.73	0.02	0.05	0.45
SE(m)	0.194	0.206	0.143	0.22	0.20	0.20	0.106	0.117	0.15
C.V	18.290	21.65	13.38	23.38	20.15	20.15	17.0	18.67	21.15

*Figures within parenthesis are original values. Data is subjected to square root transformation

Table.4 Weed dry matter under different herbicidal treatments at 60, 90 DAS in chickpea and lentil intercropping system

Treatments	*Medicago denticulata*	*Anagallis arvensis*	*Coronopus didymus*	*Rumex dentatus*	*Phalaris minor*	*Chenopodium album*	*Melilotus officinalis*	*Canada thistle*	*Malva parviflora*
Pendimethalin	1.61(0.36)	1.62(0.43)	1.56(0.21)	1.53(0.12)	1.55(0.19)	1.20(0.10)	1.18(0.04)	1.0	1.0
Fluazifop-p-butyl	1.56(0.2)	1.20(0.11)	1.54(0.15)	1.55(0.17)	1.35(0.08)	1.58(0.27)	1.0	1.0	1.0
Metribuzin	1.35(0.07)	1.41(0.27)	1.54(0.16)	1.54(0.17)	1.58(0.26)	1.17(0.04)	1.0	1.0	1.0
Imazethapyr	1.5(0.22)	1.60(0.35)	1.36(0.11)	1.55(0.18)	1.38(0.17)	1.37(0.10)	1.17(0.04)	1.0	1.0
Isoproturon	1.59(0.3)	1.40(0.22)	1.53(0.12)	1.17(0.04)	1.38(0.17)	1.53(0.13)	1.0	1.0	1.0
Hand weeding	1.37(0.13)	1.57(0.24)	1.53(0.13)	1.54(0.14)	1.55(0.18)	1.18(0.04)	1.0	1.0	1.17(0.03)
Hand weeding	1.54(0.15)	1.18(0.07)	1.56(0.21)	1.17(0.04)	1.56(0.20)	1.36(0.09)	1.0	1.0	1.0
Weed free	1.35(0.08)	1.52(0.10)	1.35(0.07)	1.34(0.06)	1.35(0.09)	1.35(0.08)	1.0	1.0	1.0
Weedy check	1.76(0.97)	1.69(0.78)	1.07(0.85)	1.69(0.73)	1.69(0.74)	1.68(0.72)	1.66(0.51)	1.39(0.19)	1.4(0.22)
C.D at 5%	0.26	0.05	0.23	0.29	0.49	0.25	0.30	0.25	0.26
SE(m)	0.11	0.11	0.08	0.099	0.12	0.155	0.10	0.08	0.08
C.V	12.59	13.52	10.03	11.71	14.41	19.35	14.98	13.71	14.01

*Figures within parenthesis are original values. Data is subjected to square root transformation

As we know, the greatest loss of yield due to weeds because they compete with the crop for light, space, nutrients, and moisture, etc. In this study, weeds affect the main crop dry matter accumulation and reduce then plant growth and development. So, this directly affects the grain yield of chickpea. However, treatment T9 (Weedy check) highest dry matter production and weed population was recorded, and lowest dry matter found in T8 (Weed-free). This study shows that the intensity of the weed population affects the dry matter of the main crop. On large scale it is not suitable and economically viable to perform hand weeding operations so to make the farming beneficial for the farmer, it is good to integrate the hand weeding operation with the use of herbicides. Metribuzin@ 1.0 kg/ ha resulted in the lowest weed population and increase crop growth and development followed by Pendimethalin and Imazethapyr. Some precautions must be taken during herbicide application at higher doses they might be harmful to the main crop.

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