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EFFECT OF DENSITY AND PLANTING ROW DISTANCE IN DILL (*Anethum graveolens* L.) ON EFFICIENCY OF THREE HERBICIDES

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ABSTRACT

Density and weeds control are the most important farming operation in order to enhance plant yield. With adoption of appropriate density, efficiency of herbicides can also be increased. In this research, the effects of different methods of weeds control at four levels: weeding, non-weeding, use of Ronstar and Gallant herbicides), planting row distance at three levels (15, 20 and 25 cm) and planting density at three levels (200, 300 and 400 plants/m^2) have been studied on dill (*Anethum graveolens* L.) growth and weeds competition. Usage of Gallant herbicide had little effect on weeds control, but application of Ronstar herbicide had favorable control on weeds. Ronstar application at densities of 200, 300 and 400 plants/m^2, decreased weeds dry weight about 34.2%, 44.1% and 50%, respectively; which the rate of decline was more severe in broadleaf weeds. Total weeds were not impressed by Gallant herbicide, but consumption of Ronstar herbicide reduced 34% of the total weeds. In most of the studied traits at Ronstar treatment, observed no significant difference among examined densities. Nonetheless, in treatments of Gallant application and non-weeding; significant reduction was observed in number and growth of weeds by increasing in plants density. Density of 400 plants/m^2 had the lowest number of weeds; weeds control method had no significant effect on most of the related traits to weeds. The highest yield of dill with amount of 437 g/m^2 was obtained in treatments of weeding and density of 400 plants/m^2. In density of 200 plants/m^2, weeds control methods had no effect on total dry weight of dill, but in density of 300 plants/m^2; treatments of weeding, applications of Ronstar herbicide and Gallant herbicide increased total dry weight of dill with amounts of 40.5, 24.6 and 27.6%, respectively as compared with non-weeding treatment. In density of 200 plants/m^2 treatments of weeding, applications of Ronstar herbicide and Gallant herbicide augmented total dry weight of dill with rates of 52.7, 17.4 and 24.8%, respectively as compared with non-weeding treatment. According to the results of this study, singly usage of Gallant and Ronstar herbicides does not seem to be desirable method for weeds control in dill. By increasing in density, more amount of dry matter was harvested per area unit. So that with increase in density from 200 to 400 plants at treatments of weeding, non-weeding, usage of Ronstar and Gallant herbicides; total dry weight of dill increased about 82, 25, 47 and 47%, respectively. Thus, by reducing weeds competition, further increase was obtained with increment of plant density. It seems that, greater increase in biomass per area unit was taken in high plant density with reduction in weeds interference.

Keywords: weeds, dill, herbicide, density, planting distance.

INTRODUCTION

With cultivation of medicinal plants, in addition to prevent from reduction in genetic diversity of medicinal plants; opportunity will be obtained for increase yield of these plants and production of compounds with high quality (Canter *et al.,* 2005). Dill is the important medicinal plant and in the last time, it was used for treatment of diseases (Bahramikia and Yazdanparast, 2008). Selection of favorable density in this plant had significant impact on plant growth and yield of essence (Bandele *et al.,* 1990).

Each crop often has its own weed; this may be due to their life cycle, growth habit and other characteristics which are necessary for successful competition with crop. When two plants use common resources such as light, water and nutrients and these resources are insufficient for optimum plant growth, competition for resources occurs between these two plants. If this competition becomes early in season, will causes to decrease in growth of plant which absorbs resources slower. Forasmuch as weeds are better compatible with environmental conditions, so in competition with crops are often successful which lead to reduction in yield of crops (Yaghoobi and Siyami, 2008). Plant density affects on duration of each stages in crops, because plants compete for light. Plants grow faster in high-density than low-density. Environmental resources are consumed faster at high densities and duration of flowering stage up to full maturity stage decreases (Langham, 2007). Density influences on rate of nutrient uptake by plants, humidity and amount of solar radiation interception (Hokmalipour *et al.,* 2010). Application of low distances for planting rows or high plant densities increase speed of canopy closure and amount of solar radiation interception and therefore improves growth speed and crop yield. Desirable plant density for each plant species is determined with consideration to several factors which ultimately affect plant yield (Fanadzo *et al.,* 2010). Babalola and Odhiambo (2008) stated that plant density in different environments affects by climate factors, soil fertility, planting date and planting pattern. Also researches have shown that depend on plant type, amount of appropriate plant density for gain of maximum yield will be different (Roth *et al.,* 2007). High plant populations can lead to creation of food and water stresses in plants (Blandino *et al.,* 2008). Alteration of planting pattern especially reduction in distance between rows reduces weeds growth and evaporation of moisture from soil surface. Usually with decrement in

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inter-row spacing even in constant plant density, received amount of photosynthetically active radiation increases. While, some researchers assert that inter-row distance has little effect on amount of received light? Recently, other researchers have proved that these inconsistencies depend on leaf area index which is relative to density severely. In experiment of these researchers, usually at high planting densities; high leaf area index depredates advantages of low inter-row distance for receiving more photosynthetically active radiation (Drouet and Kiniry, 2008).

Proper planting pattern and distance between plants has crucial role in plants yield and interference reduction with weeds. Specific pattern for a crop may be provides appropriate environment for maximizing vegetative growth and thus leads to increase in yield. Adjustment of inter-rows distance and within rows distance is the most important agricultural operations to increase crop yield and reduce competition with weeds for plants which are planted in form of row (Husain *et al.,* 2007). In a study conducted by Bandele *et al*., (1990) it was observed that weight of leaf, stem, flower and total yield of dill were more in higher densities. In cumin has been reported that number of plant per area unit has the most important role among yield components. But probably, effect of plant density deficit balances by number of inflorescences and number of seeds per plant, partly. It has been reported that number of umbels per plant or inflorescence per plants has second position from the view point of importance among yield components of cumin. So that, researchers reported that 96% of yield variation is belonged to this yield component. Also, number of seeds per inflorescence affects by environmental factors and agricultural operations (Heidari *et al.,* 2011).

This investigation was carried out in order to study effect of density and planting row distance in dill on efficiency of three herbicides.

MATERIALS AND METHODS

This experiment was conducted during cropping years of 2013-14 at the Agricultural Research Station in Agriculture Faculty of Islamic Azad University, Tabriz Branch with latitude of 38˚02′N and longitude: 46˚25′E which is located at 1348 meters above sea level. Average of annual rainfall has been reported about 310 mm and 42^{oC} for maximum absolute annual temperature and 25^{oC} for minimum absolute annual temperature. The trial was performed in form of split-split-plot design with 36 treatment combinations for each replication and total of 108 experimental plots in three replications. Studied factors were included different methods of weeds control at four levels (weeding, non-weeding, use of Ronstar herbicide and Gallant herbicide) as main factor, planting row distance at three levels (15, 20 and 25 cm) as sub agent and planting density at three levels (200, 300 and 400 plants/m^2) as sub-sub factor. Dishwashing liquid was used in order to better absorption of herbicide. Spraying was done with concentration of 2 per thousand. Amounts of herbicide consumption have been given in Table-1. On 22 June of 2013, the land was plowed and plots were prepared. Land dimension was 10×30m. Dimension of each plot was considered 2 meters by 5.5 meters. All of the plots have four planting rows which distances were 15, 20 and 25 cm based on experimental treatments. Intervals between replications and between plots were considered 1 m and 0.5 m, respectively. Also, from two sides of each plot at spaces of 0.5 m were as marginal effects. Planting was done on 24 June of 2013. First irrigation was carried out immediately after planting. Irrigation was performed until the end of July every morning and evening with low content and pressure for uniform germination. Application of density treatment was after full establishment of dill plants. At this stage, considered density was applied by removing additional plants. For this purpose, by taking consideration into density and planting row distance; plant spacing on per row has been considered in Table-2 and additional plants were removed. After thinning, irrigation was done. When sizes of dill plants reach to 8-10 cm, 100kg of urea fertilizer was used per hectare. Irrigation was done immediately after fertilization. Spraying and usage of herbicides was carried out on 21^{th} July. By using Ronstar herbicide, most of broadleaf weeds wasted but narrow leaf weeds remained. After a week, redroot pigweed and lambsquarters appeared again in the plots which spraying with Ronstar herbicide. Gallant herbicide also had desirable control on narrow leaf weeds. Required samples of dill for traits measurement were obtained with quadrat in dimension of 10 ×20 cm and all of weeds within the quadrat were also removed. In related characteristics to weeds, treatment of full weeding removed and levels of non-weeding treatment, application of Ronstar herbicide and Gallant herbicide were considered in statistical analysis. Before statistical analysis, normality test was done for the data and then by using Mstatc software, statistical analyses were performed for the data obtained from the measured traits. Duncan's multiple range test at 5% probability level was used for mean comparisons. Excel software was used for drawing charts.

Table-1. Rates of herbicide consumption in this study.

Herbicide type	**Amount of water** (liter)	**Amount of dishwashing liquid** (cc)	**Amount of herbicide** (cc)
Ronstar	12	5	20
Gallant	12	5	20

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Table-2. Planting distance of plants on row based on planting distance and investigated densities.

Distance of planting rows (cm)	**Planting density** (plant per square meter)	**distance of plants on planting rows** (cm)
15	200	3.3
15	300	2.2
15	400	1.7
20	200	2.5
20	300	1.6
20	400	1.25
25	200	2
25	300	1.3
25	400	1

RESULTS AND DISCUSSIONS

The results of variance analysis for studied traits showed that in Table-3 and Table-4.

Traits of Dill

Plant height: In this study, the highest plant height with 49.3 cm and 45.6 cm were obtained in densities of 200 and 300 plants/m^2, respectively. No significant difference for plant height was observed between densities of 300 and 200 plants, but plant height was less in density of 400 plants/m^2 as compared with densities of 300 and 200 plants/m^2. Plant height in density of 400 plants/m^2 was lower about 24.3% than density of 200 plants (Table-5).

Number of leaf: The highest number of leaf in this research was belonged to treatment of weeding and planting distance of 20cm. In this treatment, number of leaf was 21.2 which was higher about 43.4% in comparison with non-weeding treatment. Weeding treatment in other planting distances had no effect on number of leaf as compared with non-weeding treatment. Unlike weeding treatment; consumption of Ronstar and Gallant herbicides in planting space of 25cm caused to significant increase in number of leaf. At both treatments of Ronstar and Gallant herbicides in planting distance of 25cm, numbers of leaves were 16.1 and 16.7, respectively which were more about 22.9% and 27.4% as compared with non-weeding treatment (Figure-1). Undoubtedly, weeds competition cause to significant reduction in number of dill leaf. Weeds decrease amount of nutrient elements such as nitrogen in soil with absorption of foodstuffs. Deficit of nutrients in plants influences by weeds competition can leads to increase in leaves senescence and reduces number of leaves in plants (Donnison *et al.,* 2006). Mean comparisons for number of leaf affected by plant density demonstrated that maximum number of leaf with rate of 19 was obtained in density of 200 plants/m^2 which was more about 42.8% as compared with density of 400 plants/m^2. Number of leaf was 16.2 in density of 300 plants/m^2 which was higher about 21.8% in comparison to density of 400 plants/m^2. In general, it was observed that by increasing density, number of leaf had further reduction (Table-5).

Total dry weight of dill in three cutting: In this study, the highest total dry weight of dill in three cutting was obtained in weeding treatment and density of 200 plants/m^2 which was further about 52.7% in comparison to non-weeding treatment. Also in density of 300 plants, weeding of weeds augmented 40.5% of total dry weight in dill at three cutting but in density of 400 plants, weeding application had no effect on dry weight of dill. Usage of Ronstar and Gallant herbicides at densities of 300 and 200 plants led to significant augmentation in total dry weight of dill. Application of Gallant herbicide in densities of 300 and 200 plants increased dry weight of dill with amounts of 24.6% and 17.4%, respectively. Application of Ronstar herbicide in densities of 300 and 200 plants increased dry weight of dill with rates of 27.6% and 24.8%, respectively. Overall in density of 300 plants, herbicides had better effects on dill growth. In this investigation, at all of the herbicides treatments, total dry weight of dill in three cutting increased with augmentation in density. The greatest increase was obtained in weeding treatment. With increasing density from 400 to 300 plants and 200 plants, dry weight of dill increase up to 40% and 82%, respectively (Figure-2).

In high plant densities with increasing planting distance, significant reduction was obtained in dry weight of lambsquarters. In density of 200 plants/m^2, with increasing planting distance from 15cm to 20cm and 25cm, total dry weight of dill decreased about 13.7% and 21.6%, respectively (Figure-3).

It seems that among weeds control treatments; weeding was the most effective treatment which had significant effect in augmentation of dill dry weight particularly at low densities. While among methods of weeds control, application of Ronstar herbicide was less effective. Also, planting density had stability effect on this trait and in all of the planting distance treatments and weeds control methods, significant reduction was observed in dill dry weight with decreasing density. Planting density with distance of 15cm had more effect and density reduction led to decrease in dill dry weight. Plant interference on row increases with reduction in planting density and shading will be more in dill plants. Assuming that, two-dimensional surface of soil indicate the availability of resources, average of available resources for each crop is similar in different planting patterns at same density, but size and shape in availability surface of resources for each plant are variable from a hexagonal or square in uniform planting pattern to rectangular and irregular pattern. Vegetation in the early season is important for better overcoming on weeds. Therefore, crop should germinate quickly after planting before weed overcome on crop with its fast-growing. If crop cultivate in uniform planting arrangement, favorable vegetation forms early. Because plant creates proper cover so, intra-plant competition and shading on other crops in plant population reduce and delay as much as possible (Olsen *et al.,* 2012). Olsen and Weiner (2007) reported that with more uniform distribution of vegetation in canopy, leaf area per plant would be further due to reduction of plants interference. Arshad and Ranamukhaarachchi (2012) studied effect of vetch planting on one side of ridge and on both sides of ridge which they observed; LAI is more in planting on both sides of ridge. Thus, it seems that more uniform distribution of plants in the field will have an important role in plants growth. In this investigation, also found that dry yield was obtained further in low planting distance, due to more uniform distribution. In this study, at high-density of planting; planting distances demonstrated no differences from the view point of total dry weight. In a research was observed at high planting densities; high leaf area index usually depredates advantages of low inter-row distance for receiving more photosynthetically active radiation (Drouet and Kiniry, 2008).

Traits of weeds

Dry weight of Redroot pigweed (*Amaranthus retroflexus*): In this research, at third cutting the highest dry weight of pigweed with 32.8g was obtained in treatment of Gallant application and density of 200 plants/m^2 which had no significant difference with treatment of non-weeding and density of 200 plants/m^2. The lowest dry weights of pigweed with amounts of 9.8, 11.5 and 9.7g were obtained at densities of 400, 300 and 200 plants/m^2 by using Ronstar herbicide, but there were no significant statistically differences among theses three treatments. In three densities of 400, 300 and 200 plants/m^2, application of Ronstar herbicide reduces dry weight of pidweed with rates of 47.3, 57.6 and 66.8%, respectively. Usage of Gallant herbicide had no effect on dry weight of pigweed. In this investigation, at non-weeding treatment there were no significant differences among densities of 300 and 200 plants from the view point of pigweed dry weight but by increasing density from 200 to 300 plants/m^2, dry weight of pigweed reduced up to 36.5%. In application of Gallant herbicide with increasing density, greater reduction was observed in pigweed dry weight. At usage of Gallant herbicide by augmenting density from 200 to 300 and 400 plants, dry weight of pigweed decreased 21.95 and 47.2%, respectively (Table-7). Researchers have reported increase in amount of crop density by limiting effects of competition from weeds (Makarian *et al.,* 2003; Nurse and Ditommaso, 2005). According to van Acker *et al*., (1993) plant density has impressed competitive balance between weeds and crops and increase of plant density leads to reduction in weeds growth and significant decrement in yield casualties caused by competition. In this assessment, at densities of 300 and 400 plants/m^2, dry weight of pigweed affected by planting distances, but in density of 200 plants/m^2 at planting distance of 25cm, dry weight of pigweed was greater as compared with planting distance of 15cm. In density of 200 plants/m^2 at planting distance of 25cm, dry weight of pigweed was 28.5 kg which was 49.2% higher in comparison with planting distance of 15 cm. In planting distance of 15cm, there were no significant differences among studied densities from the view point of pigweed dry weight but by increasing density from 200 to 400 plants at planting spaces of 20cm and 25cm, dry weight of pigweed reduced up to 40.3 and 51.2%, respectively (Table-8).

Nordby *et al*., (2005) with assessing the effects of maize row spacing on pigweed growth concluded that biomass production, survival and regeneration of green pigweed reduced up to 80% due to maize competition. Hence, increasing plant density per area unit is one of the competition mechanisms in crops toward weeds. In this research, application of Ronstar herbicide caused to desired reduction in dry weight of pigweed. The results of Channappagoudar and Biradar (2007) showed that Ronstar herbicide with effective material of 90g. per hectare in 30 days after spraying controls weeds about 87%.

Dry weight of lambsquarters (*Chenopodium album*): In mean comparisons of lambsquarters dry weight in third cutting under influence of weed control method and plant spacing was observed that at all planting distances, application of Ronstar herbicide caused significant reduction in dry weight of lambsquarters. In planting distances of 15, 20 and 25cm, dry weight of lambsquarters at third cutting declined up to 58.1, 62.6 and 71.2%, respectively affected by usage of Ronstar herbicide (Figure-4).

The results of this research demonstrated that in third cutting, treatments of non-weeding in density of 200 plants/m^2 and application of Gallant herbicide in densities of 300 and 200 plants/m^2 had the highest dry weights of lambsquarters with amounts of 16.5, 15.5 and 15.6g, respectively. The lowest dry weight of lambsquarters was obtained with application of Ronstar herbicide. At densities of 400, 300 and 200 plants/m^2, dry weight of lambsquarters reduced about 47.9, 63.8 and 67.2%, respectively as compared with non-weeding treatment. In usage of Ronstar herbicide no difference was observed among studied densities from the view point of lambsquarters dry weight. In treatment of Gallant herbicide, there were no differences between densities of 200 and 300 plants/m^2 from the view point of lambsquarters dry weight, but with increasing density from 200 plants to 400 plants/m^2, dry weight of lambsquarters reduced about 41%. In treatment of non-weeding, density increase caused to greater increase in dry weight of lambsquarters. In treatment of non-weeding, density increase from 200 to 300 and 400 plants/m^2 caused to reduction in dry weight of lambsquarters up to 21.1% and 40%, respectively (Table-7). Increase of planting density and distance alteration in planting rows lead to increase in crop biomass and its yield which have negative effects on weeds biomass and reduce competition power in weeds, significantly (Kristensen *et al*., 2008). At investigation of lambsquarters dry weight affected by planting distance and plant density was obtained that maximum dry weight of lambsquarters with rate of 16.3g was obtained in treatment of 25cm planting distance and density of 200 plants/m^2. The minimum dry weight of lambsquarters with amount of 6.5g was belonged to 15cm planting distance and density of 400 plants/m^2. In this study at planting distances of 15cm and 20cm, there were no significant difference between densities of 200 and 300 plants/m^2 from the view point of lambsquarters dry weight, but in both distances with increasing planting density from 200 plants to 300 and 400 plants/m^2, lambsquarters dry weight declined up to 32.9 and 31.3%, respectively. In planting distance of 25cm with augmenting plant density from 200 plants to 300 and 400 plants, lambsquarters dry weight reduced till 26.9 and 42.3%, respectively. Thus, it seems that effect of plant density was higher at 25cm planting space (Table-8).

With consideration to the results of this study, Ronstar application was caused significant reduction in lambsquarters dry weight. Also, usage of Ronstar herbicide had favorable control on lambsquarters. Lambsquarters which had been appeared after herbicide application had low growth. Heidari *et al.,* (2011) also reported that weed which is germinated earlier, will has further growth and will produce greater leaf area.

Total dry weight of weeds: The highest total dry weight of weeds with 48g was obtained in both treatments of non-weeding and application of Gallant herbicide at density of 200 plants/m^2. The lowest dry weight of weed was belonged to treatment of Ronstar application at densities of 400, 300 and 200 plants with reduction of 34.2, 44.1 and 50%, respectively. Usage of Gallant herbicide had no effect on weed dry weight in any of the densities. Also, no significant differences were observed among studied densities from the view point of weed dry weight. Nonetheless, in treatments of non-weeding and application of Gallant herbicide, there were significant differences between studied densities from the view point of total dry weight of weed. In non-weeding treatment with increase density from 200 plants to 300 and 400 plants, total dry weight of weeds declined up to 10.4 and 27%, respectively. It was observed that in treatment of 400 plants, further reduction was obtained in total dry weight of weed as compared with density of 300 plants. In treatment of Gallant application, there was no significant difference between densities of 200 and 300 plants from the view point of dry weight of weeds, but with increasing density from 200 to 400 plants/m^2; total dry weight of weeds reduced up to 31% (Table-7).

By examining the total dry weight of weeds affected by planting distance and plant density was observed that treatment of 25cm planting distance and density of 200 plants/m^2 had the highest total dry weight of weed with rate of 47 g. In planting spaces 15cm and 25cm, no significant difference was observed between plant densities of 200 and 300 plants, but with increasing density from 200 to 400 plants/m^2 at planting distances of 15cm and 20cm, total dry weight of weeds reduced up to 14.2 and 21.3%, respectively. In planting distance of 25cm by augmenting plant density, highest increase was obtained in weeds dry weight. With increasing plant density from 200 to 300 and 400 plants, weeds dry weight decreased about 17 and 34%, respectively (Table-8). At high plant densities, weeds dry weight was less. One of the competition mechanisms in crops toward weeds is increasing plant density per area unit. So that, some researchers have reported augmentation in amount of crop density with limiting effects of competition caused by weeds (Nurse and Ditommaso, 2005). By increasing crop density, increase of competition between crop and weed declines chance of achieving growth main resources for weeds. On the other hand, presence of crop canopy can create microclimates alterations which its soil temperature, moisture, and light (quantity and quality) become alternate toward the ground without crop vegetation and thus make it unfavorable for germination of weeds (Huarte and Bebech Arnold, 2003; Leblance *et al*., 2002).

Application of Gallant herbicide had low effect on weeds dry weight, but usage of Ronstar herbicide had desirable control on weed dry weight. Also, Aktar *et al*. (2013) in the study of lentils at field condition found that Ronstar herbicide reduced weed biomass about 46%. Field observations showed that most of broad-leaved weeds wasted with using Ronstar herbicide, but after two weeks from application of Ronstar herbicide, plants of pigweed and lambsquarters appeared again, but these plants had lower growth.

Number of seed in Redroot pigweed: In mean comparisons of pigweed seed number under influence of weeds control and plant density was observed that the largest number of pigweed seeds with rate of 12960 was obtained in treatment of non-weeding and density of 200 plants/m^2. In densities of 400 and 300 plants/m^2, no significant difference was observed between treatments of herbicide with non-weeding from the view point of pigweed seed number, but in density of 200 plants/m^2, both herbicides of Gallant and Ronstar caused to significant reduction in pigweed seed number. In density of 200 plants/m^2, application of Gallant and Ronstar herbicides declined number of pigweed seed up to 53.2 and 33.9%, respectively as compare with non-weeding treatment. Hence, treatment of Ronstar application had caused greater reduction in comparison with application of Gallant herbicide. At treatment of Ronstar application, no significant difference was found among density treatments from the view point of pigweed seed number, but in treatments of non-weeding and Ronstar application, there was difference between studied densities from the view point of pigweed seed number. In treatments of non-weeding with increasing plant density from 200 plants to 300 and 400 plants, number of pigweed seed decreased up to 44.8 and 43.1%, respectively. In non-weeding treatment no significant difference was found between two densities of 200 plants and 300 plants from the view point of pigweed seed number. In treatment of Gallant application, no significant difference was observed between densities of 200 plants and 300 plants from the view point of pigweed seed number, but by augmenting density from 200 to 300 plants; number of pigweed seed reduced about 41.1% (Table-7). Application of Ronstar herbicide caused to desired reduction in number of pigweed seed. Researchers have reported that herbicides reduce weeds population at farm level and thereby decrease amount of weeds seed production per area unit (Rahman *et al.,* 2001; Skora Neto, 2001).

Number of seed in lambsquarters: Application of Gallant herbicide had no impact on number of seeds in lambsquarters, but application of Ronstar herbicide caused to significant reduction in number of lambsquarters seed. In treatment of Ronstar application, number of lambsquarters seed was 1371 which was 51.2% lesser as compared with non-weeding treatment (Table-6). Most of lambsquarters wasted after spraying of Ronstar herbicide, nonetheless after two weeks, new lambsquarters appeared at farm level which had less growth and seed production was lower. Benvenuti (2011) reported that time of weeds emergence affect on number of weeds seed; because under conditions which weeds germination delay, shading of crop will be more on weeds. Thus, production amount of weeds seed will decrease, due to shading. In this probe, there were no significant differences between densities of 200 and 300 plants from the view point of lambsquarters seed number, but in density of 400 plants/m^2; number of lambsquarters seed was lesser as compared with lower densities. In density of 400 plants/m^2, number of lambsquarters seed was 1860 which was 27.4% lesser in comparison with density of 200 plants/m^2 (Figure-5).

Seed weight of Redroot pigweed: With evaluation of mean comparisons for seed weight of pigweed affected by treatments of weeds control and density were observed that dry weight of pigweed seed caused to significant decrease in response to Ronstar herbicide at densities of 300 and 200 plants. The least weight of pigweed seed was obtained with application of Ronstar herbicide at densities of 300 and 200 plants, which were 60.3 and 70.2% lower, respectively as compared with non-weeding treatment. The highest weights of pigweed seed were obtained in two treatments of non-weeding and Gallant application at density of 200 plants/m^2. Only treatment of Ronstar application demonstrated no significant difference between densities from the view point of seed weight in pigweed, but in treatments of non-weeding and Gallant application, augmentation of density caused to significant reduction in weight of pigweed seed. In both treatments, more increase of plant density led to severe reduction in weight of pigweed seed. In treatment of non-weeding with increasing density from 200 plants to 300 and 400 plants, weight of pigweed seed declined up to 32 and 57%, respectively. In application of Gallant herbicide by increase plant density from 200 to 300 plants, weight of pigweed seed decreased about 29.8 and 62.8%, respectively (Table-7).

With assessment in weight of pigweed seed influenced by planting distances was observed that weight of pigweed seed was higher at planting spaces of 20cm and 25 cm as compared with 15cm planting distance. At planting distances of 20cm and 25cm amaranth seed weight had reduction about 24 and 31.1%, respectively in comparison with 15cm planting distance. No difference was observed between row spacing of 20cm and 25 cm from the view point of pigweed seed weight (Figure-6).

Seed weight of lambsquarters: Investigation of lambsquarters seed weight showed that among herbicide treatments, Ronstar herbicide and only in density of 200 plants/m^2 caused to significant reduction in lambsquarters seed weight. In density of 200 plants/m^2, weight of lambsquarters seed was obtained 81g. which was 36.7% lower as compared with non-weeding treatment. It is expected that application of Ronstar herbicide causes to significant reduction in weight of lambsquarters seed, although usage of Ronstar reduces weeds density but remained weeds can grow better with having more space. In application of Ronstar herbicide, there was no difference between studied densities from the view point of lambsquarters seed weight, but in treatments of non-weeding and Gallant herbicide with increasing density, significant decrease was obtained in lambsquarters seed weight. In treatment of non-weeding with increasing plant density from 200 plants to 300 and 400 plants, weight of lambsquarters seed declined about 28.1 and 36.7%, respectively. In non-weeding treatment, no significant difference was found between densities of 300 and 400 plants from the view point of lambsquarters seed weight. In treatment of Gallant herbicide, increase of density from 200 plants to 300 and 400 plants/m^2 decreased lambsquarters seed weight up to 12.8 and 31.2%, respectively (Table-7). Ronstar application under farm condition caused to destruction in most of lambsquarters. Nonetheless after spraying, new lambsquarters appeared at farm level which had less growth and will produce lower seed. Boerboom (2002) reported, weeds that delay in germination will produce fewer seeds, thus weeds dry weight will decrease per plant.

CONCLUSIONS

Field observations showed that application of Ronstar herbicide after a week ruined most of pigweed and lambsquarters. Also application of Gallant herbicide had favorable control on narrow leaf weeds but it was observed that growth and number of broadleaf weeds was higher in plots which was used Gallant herbicide. Also the

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results of this study demonstrated that reduction in narrow leaf weeds leads to increase in growth of broadleaf weeds. Therefore, broadleaf weeds have more competitive power due to better use of resources in existent opportunities. Hence, it seems usage of Ronstar and Gallant herbicides and simultaneously controls of broad leaf and narrow leaf weeds would be desirable. However, evaluated herbicides had negative effects on dill and caused to burn in dill. In general, it seems that use of Ronstar and Gallant herbicides had no desirable influence on dill. Thus according to the results, just application of Ronstar and Gallant herbicides does not seem to be appropriate method for weeds control in dill. In this research, planting distance had no stable effect on dill, but in general with increasing planting distance; dry weight of dill was lower in different cutting which its reason could be increase in plants interference on rows. By increasing density, more amount of dry matter was harvested per area unit. In this study with reduction of weeds competition, further increase was obtained with increasing plant density. Also it appears that with decrease in density, necessity to favorable herbicides for weeds control will increase.

Table- 3. Analysis of variance for studied traits in dill.

S.O.V	df	Plant height	Number of leaves	Plant dry weight
Replication	2	100.922	8.876	103.516
Weed control	3	282.371	46.574*	34507.446**
main error	6	189.307	7.351	616.314
Planting distance	2	29.229	22.188*	19699.063**
Planting distance × weed control	6	124.277	39.627**	2450.198
Subsidiary error	16	151.599	4.461	1171.122
Density	2	1351.461**	297.889**	128537.841**
Weed control × density	6	45.226	31.413	8082.102**
Planting distance × density	4	96.962	23.002	4491.535**
weed control× planting distance × density	12	80.815	7.2	1214.504
Sub-Subsidiary error	48	98.173	18.074	897.731
Coefficient of variation (%)		22.47	26.24	10.17

* and **: significant at 5% and 1% probability level, respectively.

Table-4. Analysis of variance for studied traits in weeds.

S.O.V	df	pigweed dry weight	lambsquarters dry weight	lambsquarters seed Number	pigweed seed Number	lambsquarters seed weight (g)	pigweed seed weight (g)	Total dry weight of weeds
replication	2	21.123*	11.118*	38104.11	3920597	0.026	0.464	7.186
Weed control	2	1953.863**	604.347**	15953461.185**	117794724.9**	0.545*	134.480**	2989.279**
main error	4	2.987	1.764	121041.3	2545803	0.04	0.731	16.692
Planting distance	2	80.839	100.464**	1319993	1927588	0.009	13.746*	171.803*
Planting distance × weed control	4	32.757	27.659**	639905.8	9735810	0.009	1.588	40.407
Subsidiary error	12	38.872	4.977	764379.9	6936358	0.037	2.429	30.024
Density	2	540.260**	145.280**	3435516.76**	95484406.2**	0.590**	97.540**	699.654**
Weed control × density	4	146.135**	41.763**	396933.9	26221120.6**	0.138**	27.082**	142.818**
Planting distance × density	4	96.938*	15.815*	564061.7	4103973	0.014	3.168	88.507**
weed control× planting distance × density	8	43.526	5.812	219692.7	9506588	0.011	4.049	8.437
Sub-Subsidiary error	36	28.107	5.227	445842.1	4930663	0.023	2.451	16.608
Coefficient of variation (%)		26.27	21.65	29.73	28.5	15.83	28.96	11.22

* and **: significant at 5% and 1% probability level, respectively.

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Table-5. Mean comparisons of the studied traits in dill affected by planting density.

Density (plant/m^2)	**Plant height** (cm)	**Number of leaf**
200	49.31 a	19.05 a
300	45.62 a	16.25 b
400	37.35 b	13.3 c

Table-6. Mean comparisons of the studied traits in weeds under influence of weeds control methods.

weeds control methods	**Number of lambsquarters seed in third cutting**	**Number total weeds in third cutting**
Non-weeding	2814. a	43.78 a
Ronstar herbicide	1371. b	28.86 b
Gallant herbicide	2553. a	43.01 a

Table-7. Mean comparisons of the studied traits in weeds affected by interaction of weeds control methods and planting density.

Weeds control methods	**Density** (plants/m^2)	**Pigweed dry weight** (g)	**Lambsquarters dry weight** (g)	**Number of redroot seed**	**Total dry weight of weeds**	**Lambsquarters Seed weight** (g)	**Pigweed Seed weight** (g)
Non-weeding	400	18.63 c	9.825 c	7371. cd	35.40 c	0.8186 c	4.014 c
Non-weeding	300	26.64 b	13.09 b	7145. de	43.63 b	0.9268 c	6.390 b
Non-weeding	200	29.39 ab	16.53 a	12960. A	48.21 a	1.281 a	9.493 a
Ronstar	400	9.801 d	5.109 d	5270. de	23.41 d	0.7832 c	3.064 c
Ronstar	300	11.50 d	4.735 d	4835. e	24.39 d	0.8016 c	2.549 c
Ronstar	200	9.776 d	5.458 d	6058. de	24.76 d	0.8171 c	2.880 c
Gallant	400	17.38 c	9.108 c	6294. de	33.04 c	0.8686 c	3.696 c
Gallant	300	25.62 b	15.53 a	9488. bc	46.01 ab	1.095 b	6.801 b
Gallant	200	32.89 a	15.67 a	10700. B	48.16 a	1.253 a	9.775 a

Table-8. Mean comparisons of the studied traits in weeds affected by interaction of planting distance and plant density.

planting distance (cm)	**Density** (plants/m^2)	**Pigweed dry weight** (g)	**Lambsquarters dry weight** (g)	**Total dry weight of weeds** (g)
15	400	17.34 cde	6.591 e	30.06 c
15	300	19.68 bcd	9.902 bcd	37.64 b
15	200	19.15 bcde	9.783 bcd	35.15 b
20	400	14.55 de	7.963 de	30.51 c
20	300	20.28 bc	11.46 bc	37.34 b
20	200	24.34 ab	11.56 bc	38.86 b
25	400	13.92 e	9.488 cd	31.29 c
25	300	23.80 ab	11.98 b	39.05 b
25	200	28.57 a	16.31 a	47.12 a

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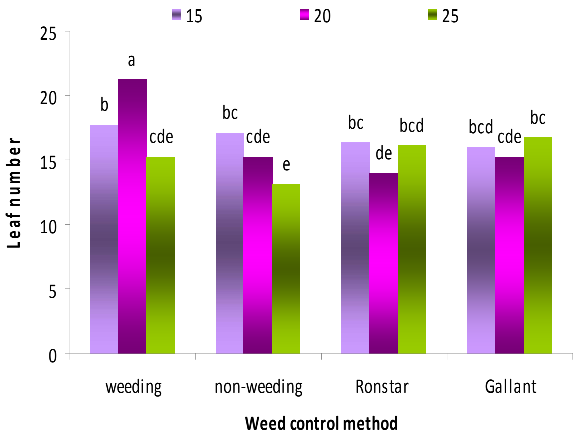

Figure-1. Mean comparisons for number of leaf affected by different planting distances in dill.

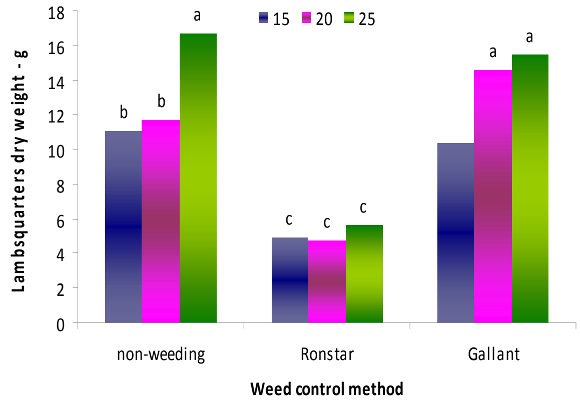

Figure-4. Mean comparisons for dry weight of lambs quarters at three cutting affected by weeds control method in different planting distances.

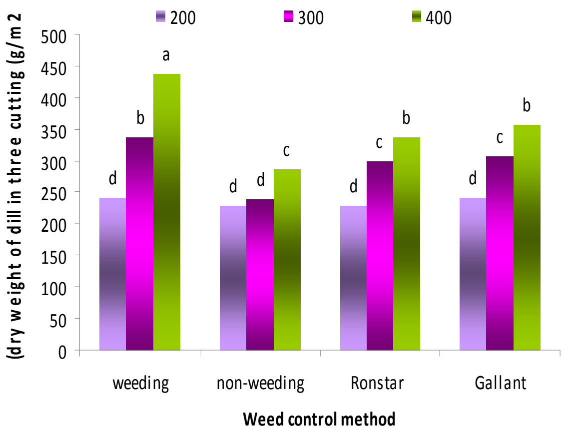

Figure-2. Mean comparisons for total dry weight of dill at three cutting affected by different weeds control methods and different densities in dill.

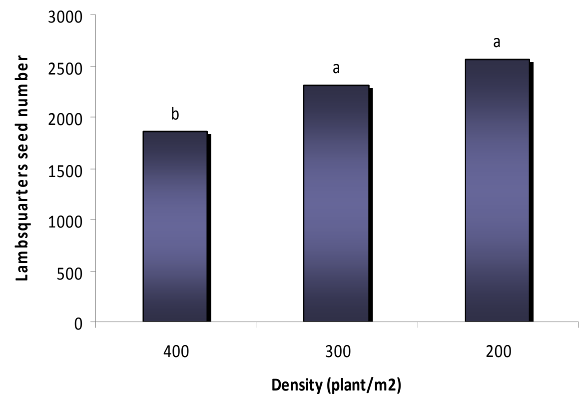

Figure-5. Mean comparisons for number of seeds in lambsquarters affected by different densities.

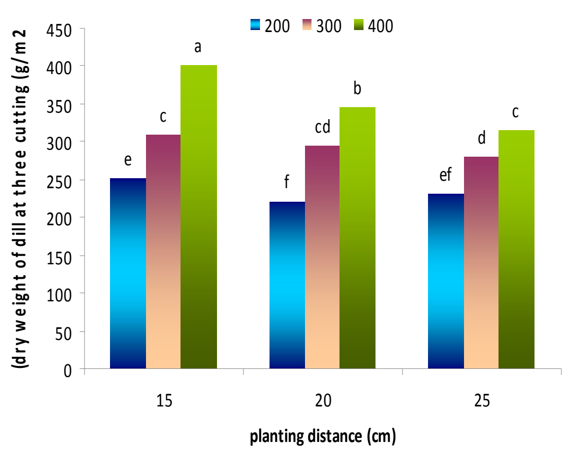

Figure-3. Mean comparisons for total dry weight of dill at three cutting affected by planting distances and different densities in dill.

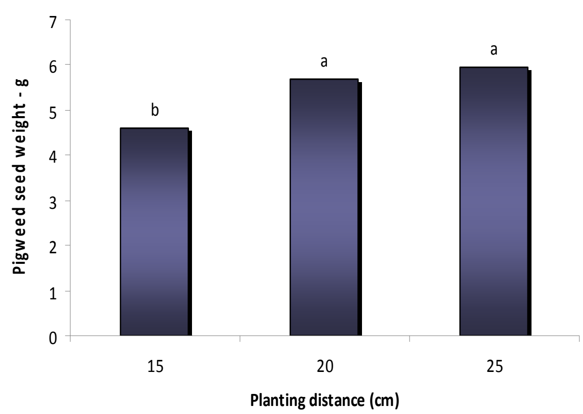

Figure-6. Mean comparisons for pigweed seed weight affected by different planting distances.

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