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Effect of pruning and row distance on some characteristics in Karela

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Key words: Length of fruit, weight of 1000 grain, grain yield, diameter of fruit .

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Abstract

Medicinal plant is defined as any substance with one or more of its organ containing properties that can be used for therapeutic purposes or which can be used as precursors for the synthesis of various drugs. Momordica charantia (MC), also known as karela, bitter melon or balsam pear, is one of the plants commonly used for its glucose-lowering effects. Momordica charantia, commonly known as "Karela" (Family Cucurbitaceae), is a tropical household vegetable used as daily food and also as folk medicine especially for diabetes. Optimum plant population is the prerequisite for obtaining maximum yield. Plant density is invariably linked with yield, the more plant stands there are up to a certain limit, the higher the expected yield. The field experiment was laid out in randomized complete block design with facrorial design with three replications. Treatments consisted of row distance in four level (50, 75, 100 and 125 cm) and pruning in three level (no pruning, pruning of main stem and pruning of sub stem). Analysis of variance showed that the effect of row distance on all characteristics was significant.

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Introduction

Medicinal plant is defined as any substance with one or more of its organ containing properties that can be used for therapeutic purposes or which can be used as precursors for the synthesis of various drugs. Medicinal plants contain numerous biologically active compounds such as carbohydrates, proteins, enzymes, fats and oils, minerals, vitamins, alkaloids, quinones, terpenoids, flavonoids, carotenoids, sterols, simple phenolic glycosides, tannins, saponins, polyphenols etc. Traditional medicine refers to health practices, knowledge and beliefs incorporating plants, animals and mineral based medicines, spiritual therapies, manual techniques and exercises, applied singularly or in combination to treat, diagnose and prevent illnesses or maintain wellbeing (Beloin *et al*, 2005). Over the years, medicinal plants have been found useful in the treatment and management of various health problems. Traditional medicine is undoubtedly a reliable alternative approach to health care delivery in the metropolis because it is cheap, easily accessible and efficacious. Herbal drugs are invariably single plant extracts of fractions thereof or mixtures of fractions/extracts from different plants. Traditional plant medicines might offer a natural key to treat various human ailments. In recent years, there has been an increasing interest by researchers in the use of naturally occurring biologically active compounds of medicinal value (Wu and Ng, 2008). Momordica charantia (MC), also known as karela, bitter melon or balsam pear, is one of the plants commonly used for its glucose-lowering effects (Ahmed *et al*, 1998). Momordica charantia, commonly known as “Karela” (Family Cucurbitaceae), is a tropical household vegetable used as daily food and also as folk medicine especially for diabetes. For the first time, Rivera (1941) studied the chemical properties of M. charantia and isolated an alkaloid ‘momordicine’ from the alcoholic extract, which was reported to be hypoglycaemic in nature. The parts of the plant commonly used include the whole plant, its fruit or seeds, all of which are bitter due to the presence of the chemical momordicin (Beloin *et al*, 2005). Preparations that have been reported range from injectable extracts and fruit juice to fried melon bits (Welihinda *et al*, 1986; Shane-McWhorter, 2001; Beloin *et al*, 2005). It is also an established fact that many pharmaceutical drugs used for the treatment of different diseases have a plant origin (Bailey and Day, 1989). The MC contains anti-hyperglycemic chemicals include glycosides, saponins, alkaloids, fixed oils, triterpenes, proteins and steroids (Murakami *et al.*, 2001; Erden *et al.*, 2010). These chemicals are concentrated in fruits of the MC, therefore fruit of the MC has shown more pronounced anti-hyperglycemic activity (Grover and Yadav, 2004). Presence of antioxidants in the fruits and vegetables such as vitamin C, E, carotenoids, lycopenes and flavonoids are also important in prevent free radical injury (Semiz and Sen, 2007). Total flavonoid and phenol contents of MC extract were analyzed and revealed that MC extract possess potent (DPPH) radical scavenging activity (Wu and Ng, 2008). Maximum crop production can be achieved by development of improved crop varieties and suitable growing environment and soil with optimum plant population ha-1. Optimum plant population is the prerequisite for obtaining maximum yield (Trenton *et al.*, 2006; Gustavo *et al.*, 2006). Plant density is invariably linked with yield, the more plant stands there are up to a certain limit, the higher the expected yield (Bertoia *et al.*, 1998). The dominant production practice is for farmers to plant crops (cereals) at spacings in the range of 30-35cm, which on average gives about 44,000 to 38,000 plants per hectare (Balcet and Candlar, 1981). In dense population most plants remain barren; ear and ear size remain smaller, crop become susceptible to lodging, disease and pest, while plant population at sub-optimum level resulted lower yield per unit area (Nasir, 2000). There are a number of biotic and abiotic factors those affect maize yield considerably; however, it is more affected by variations in plant density than other member of the grass family (Vega *et al.*, 2001). Plant populations affect most growth parameters of maize even under optimal growth conditions and therefore it is considered a major factor determining the degree of competition between plants (Sangakkara *et al.*, 2004). The grain yield per plant is decreased (Luque *et al.*, 2006) in response to decreasing light and other environmental resources available to each plant (Ali *et al.*, 2003). Cox and Cherney (2001) reported that increasing plant density increased dry matter (DM) yield of corn and the difference in DM yield between the two plant densities (32000 and 47000 plants/ac) was 13.7%. However, maximum forage corn yields have also been reported at 79000 plants ha-1 (Graybill *et al.*, 1991) and 100000 plants ha^{-1} (Sparks, 1988). Edwards *et al.* (2005) reported dry matter accumulation increase for corn hybrids at high than at low density due to light interception. Ayisi and Poswall (1997) reported that leaf area index is major factor determining photosynthesis and dry matter accumulation. Also, Al-Suhaibani (2011) stated that fresh and dry weights were increased at high plant density of Pearl Millet (*Pennisetum glaucum* L.) and high plant density produced the highest leaf area index. Planting density probably influences all crop traits. In plants, the distance between plant rows has influenced plant height, stem and canopy diameter, number of leaves, and root yield (ROJAS *et al.*, 2007). The distance between plants on the row has influenced all traits previously mentioned, except plant height and stem diameter (ROJAS *et al.*, 2007). In addition, planting density maintains a relation with other components of the crop's production system, including cultivars, water, and applied nutrients, competition with weeds, and incidence of diseases and pests (AYOOLA; MAKINDE, 2007; LÓPEZ-BELLIDO *et al.*, 2005; OPARA-NADI; LAL, 2006). Due to the importance of planting density, several studies have been conducted with cassava, at planting densities that ranged from 6,666 plants ha-1 (ROJAS *et al.*, 2007) to 27,777 plants ha-1 (GUERRA *et al.*, 2003). Larger populations (of up to 50,000 plants ha-1) have been tested to determine their effects on the above-ground part of the plant (LIMA *et al.*, 2002). Densities to evaluate their effects on root yield were obtained both by varying of the spacing between plants and keeping the spacing between rows constant or by varying of the spacing between rows and between plants. Removing older canes (more of five years old) from the base of the mature plant, is essential to maintain a constant production over the years, since promotes the development of new branches from adventitious buds on the crown or the base of primary branches (Siefker and Hancock, 1986; Williamson *et al.*, 2004) (Jansen, 1997). Although pruning reduces the number of fruits per plant, it also leads to an increase in fruit size that compensates for the final yield per plant (Siefker and Hancock, 1986; Jansen, 1997; Strik *et al.*, 2003) and improves its quality (Siefker and Hancock, 1986; Pritts, 2004). In addition, an adequate pruning technique improves root development in young individuals (Strik and Buller, 2005), gives the plant an open spatial configuration which facilitate pest control, enhancing agrochemical products efficiency and plant aeration (Hanson *et al.*, 2000). It also improves the leaf:fruit ratio (Siefker and Hancock, 1986; Jansen, 1997; Maust *et al.*, 1999, Pritts, 2004; Strik and Buller, 2005), increase light penetration into the canopy and therefore improves color and ripeness (Pritts, 2004). Studies (GUERRA *et al.*, 2003; ROJAS *et al.*, 2007) have demonstrated that the planting density effect on root yield varies with cultivar. In other words, an increased planting density may increases, reduces, or maintains cassava root yield, depending on the cultivar that is evaluated. Pruning is one of the most important technical treatments applied on fruit trees. Throughout the tree's life, pruning ensures that limbs are strong enough to support fruit and that branches are properly angled to allow in sufficient sunlight for flower buds to develop and for fruit to ripen. Pruning not only considerably improves regeneration processes of damaged branches and reduces the size of tree crowns, but also reduces their excessive height (Carlson 1982; Mika 1986; Radajewska and Szklarz 2008; Szklarz and Radajewska 2009). Pruning is another method that can be utilized for canopy management. Much like sanding, pruning opens the canopy and encourages new productive growth (Marucci, 1987). Pruning also has the potential benefit of breaking apical dominance. The removal of apical dominance would allow lateral buds to grow (Roper *et al.*, 1993). This results in an increase of new uprights that have to potential of fruiting the following year. Pruning promotes good air flow throughout the fruit tree, which helps prevent common tree diseases. Pruning is also effect fruit external and internal quality properties such as color development, total soluble solid/acidity balance etc (Lord and Greene 1982). Pruning treatments can be classified according to time (winter and summer) or development stage of trees (young, middle and older stages). Pepper plants have a branching habit; therefore, fruit development is controlled by restricting the branching pattern to 1, 2, 3 and 4 main branches. The reasons for pruning bell pepper under greenhouse conditions are to train plant to grow upright in order to facilitate light penetration all over the leaf canopy, improve fruit set and obtain early fruit ripening and high yield of large sized fruits (Jovicich *et al.*, 2004; Zende, 2008). Moreover, pruning is effective in improving air circulation which reduces relative humidity and limits the spread of diseases (Esiyok *et al.*, 1994). Pruning methods vary with different branching habits of Capsicum cvs. and under different plant densities (Dasgan and Abak, 2003; Maniutiu *et al.*, 2010). The prime objective of the pruning practice is obtaining proper balance between fruit number and fruit size by improved canopy management. Due to the heavy vegetative growth and fruit load on the colored pepper plants (Shaw and Cantliffe, 2002), shoot pruning is important factor in proper utilization of production area (Maniutiu *et al.*, 2010). Pruning plants to 2, 3 or 4 shoots was reported to be effective in increasing yield and reducing fruit size. Thus, the limitation of shoot number allows the increase in fruit quality (Cebula, 1995). Several studies have reported an increase in fruit yield of sweet pepper with increase in shoot number under soilless media in protected agriculture (Cebula, 1995; Jovicich *et al.*, 2004; Maboko *et al.*, 2012). Strik and Poole (1991 and 1992) also evaluated the effectiveness of pruning on yield. They showed that light, medium, and heavy treatments had reduced yields in the years of treatment. Light treatments had a significantly greater yield than the control in the year following treatments while medium and heavy treatments were had lower yields than the control. Sanding and pruning have shown the potential to be beneficial for excessively vegetative bogs. Each treatment is capable of increasing new upright growth and providing the benefits associated with a less dense canopy. However, sanding has a couple drawbacks when compared to pruning. Two of these drawbacks are the increasing price of sand and the non-uniformity of sand deposition (Hunsberger *et al.*, 2006). Motivation and aims of the study are Effect of pruning and row distance on some characteristics in karela.

Material and methods

Location of experiment

The experiment was conducted at the research Station in zahak (In Iran) which is situated between 54° North latitude and 31° East longitude and at an altitude of 480m above mean Sea Level.

Composite soil sampling

The soil of the experimental site belonging loam. Composite soil sampling was made in the experimental area before the imposition of treatments and was analyzed for physical and chemical characteristics.

Field experiment

The field experiment was laid out in randomized complete block design with facrorial design with three replications.

Treatments

Treatments consisted of row distance in four level (50, 75, 100 and 125 cm) and pruning in three level (no pruning, pruning of main stem and pruning of sub stem).

Data collect

Data collected were subjected to statistical analysis by using a computer program MSTATC. Least Significant Difference test (LSD) at 5 % probability level was applied to compare the differences among treatments` means.

Results and discussion

Diameter of fruit

Analysis of variance showed that the effect of row distance on diameter of fruit was significant (Table 1). The maximum of Plant height of treatments 125 cm was obtained (Fig 1). Analysis of variance showed that the effect of pruning on diameter of fruit was significant (Table 1). The maximum of diameter of fruit of treatments pruning of sub stem was obtained (Fig 2).

Table 1. Anova analysis of the karela affected by pruning and row distance.

S.O.V	df	Length of fruit	Weight of 1000 grai	Grain yiel	Diameter of fruit
R	2	23.11	685.02	7291.75	0.606
row distance	3	113.07**	362.02**	31355.06**	9.526**
pruning	2	377.52**	1509.36**	18632.25**	2.811*
row distance * pruning	6	17.15**	30.47ns	2567.06ns	0.190ns
Error	22	4.53	23.08	1817.78	0.588
CV	-	-	-	-	-
		9.37	2.71	5.13	10.83

*, **, ns: significant at $p<0.05$ and $p<0.01$ and non-significant, respectively.

Optimum plant population is the prerequisite for obtaining maximum yield (Trenton *et al.*, 2006; Gustavo *et al.*, 2006). Plant density is invariably linked with yield, the more plant stands there are up to a certain limit, the higher the expected yield (Bertoia *et al.*, 1998). The dominant production practice is for farmers to plant crops (cereals) at spacings in the range of 30-35cm, which on average gives about 44,000 to 38,000 plants per hectare (Balcet and Candlar, 1981).

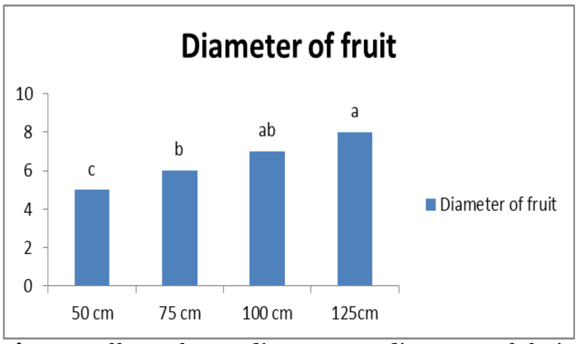

Fig. 1. Effect of row distance on diameter of fruit (Any two means not sharing a common letter differ significantly from each other at 5% probability).

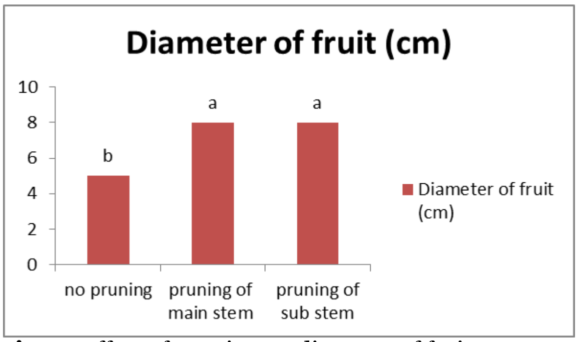

Fig. 2. Effect of pruning on diameter of fruit.

Grain yield

Analysis of variance showed that the effect of row distance on grain yield was significant (Table 1). The maximum of grain yield of treatments 75 cm was obtained (Fig 3). Analysis of variance showed that the effect of pruning on grain yield was significant (Table 1).

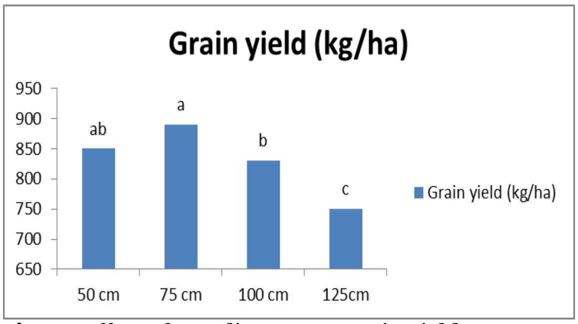

Fig. 3. Effect of row distance on grain yield.

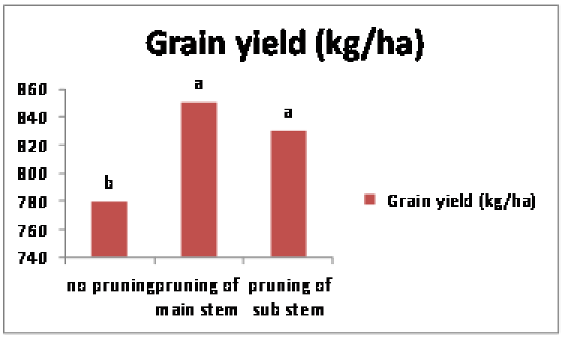

Fig. 4. Effect of pruning on grain yield.

The maximum of grain yield of treatments pruning of main stem was obtained (Fig 4). In dense population most plants remain barren; ear and ear size remain smaller, crop become susceptible to lodging, disease and pest, while plant population at sub-optimum level resulted lower yield per unit area (Nasir, 2000).

Weight of 1000 grain

Analysis of variance showed that the effect of row distance on weight of 1000 grain was significant (Table 1). The maximum of weight of 1000 grain of treatments 125 cm was obtained (Fig 5). Analysis of variance showed that the effect of pruning on weight of 1000 grain was significant (Table 1).

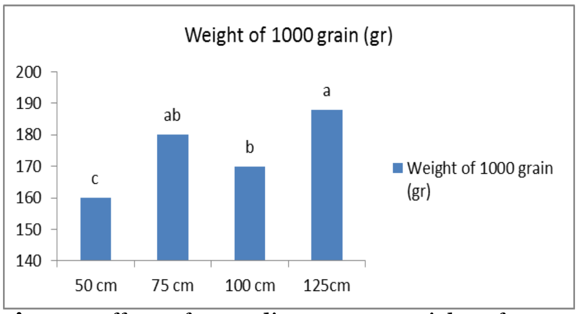

Fig. 5. Effect of row distance on weight of 1000 grain.

The maximum of weight of 1000 grain of treatments pruning of main stem was obtained (Fig 6). The grain yield per plant is decreased (Luque *et al.*, 2006) in response to decreasing light and other environmental resources available to each plant (Ali *et al.*, 2003). Cox and Cherney (2001) reported that increasing plant density increased dry matter (DM) yield of corn and the difference in DM yield between the two plant densities (32000 and 47000 plants/ac) was 13.7%. However, maximum forage corn yields have also been reported at 79000 plants ha-1 (Graybill *et al.*, 1991) and 100000 plants ha-1 (Sparks, 1988). Edwards *et al.* (2005) reported dry matter accumulation increase for corn hybrids at high than at low density due to light interception. Ayisi and Poswall (1997) reported that leaf area index is major factor determining photosynthesis and dry matter accumulation. Also, Al-Suhaibani (2011) stated that fresh and dry weights were increased at high plant density of Pearl Millet (*Pennisetum glaucum* L.) and high plant density produced the highest leaf area index. Planting density probably influences all crop traits. In plants, the distance between plant rows has influenced plant height, stem and canopy diameter, number of leaves, and root yield (ROJAS *et al.*, 2007). The distance between plants on the row has influenced all traits previously mentioned, except plant height and stem diameter (ROJAS *et al.*, 2007).

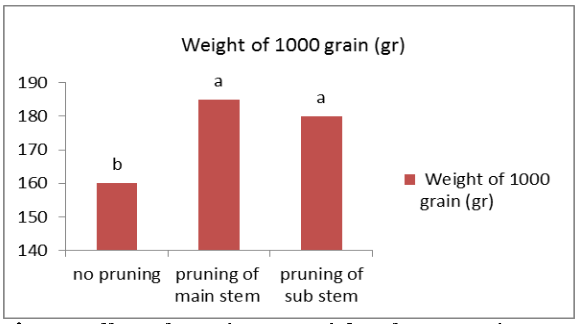

Fig. 6. Effect of pruning on weight of 1000 grain.

Length of fruit

Analysis of variance showed that the effect of row distance on length of fruit was significant (Table 1). The maximum of Plant height of treatments 125 cm was obtained (Fig 7). Analysis of variance showed that the effect of pruning on length of fruit was significant (Table 1). The maximum of length of fruit of treatments pruning of sub stem was obtained (Fig 8). Pruning treatments can be classified according to time (winter and summer) or development stage of trees (young, middle and older stages). Pepper plants have a branching habit; therefore, fruit development is controlled by restricting the branching pattern to 1, 2, 3 and 4 main branches.

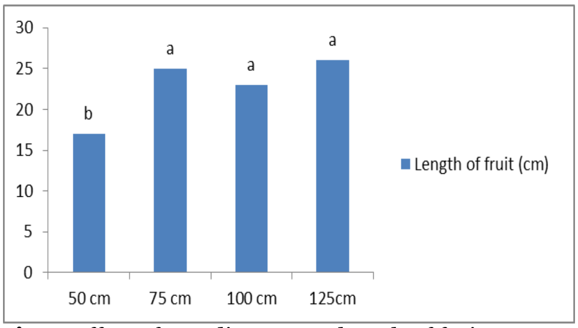

Fig 7. Effect of row distance on length of fruit.

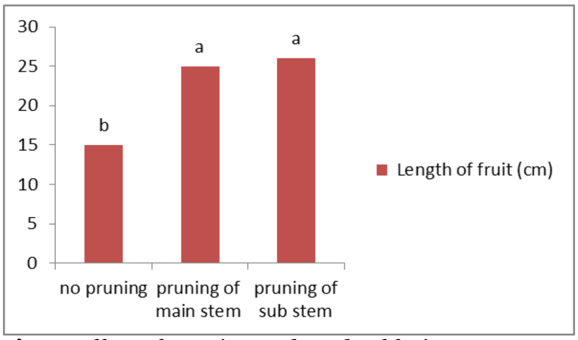

Fig 8. Effect of pruning on length of fruit.

The reasons for pruning bell pepper under greenhouse conditions are to train plant to grow upright in order to facilitate light penetration all over the leaf canopy, improve fruit set and obtain early fruit ripening and high yield of large sized fruits (Jovicich *et al.*, 2004; Zende, 2008).

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