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Original Article

Feasibility Study of Cultivation of Vegetables Using a Native Planter in Khuzestan

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ABSTRACT

Objective: In recent years, farmers have shown great interest to using native drill planter rather than complex planters to grow vegetables. **Methods:** In this study, we tested a native planter Independent variables were the two types of substrate surface (asphalt and plowed field), three ground speed (3, 5 and 7 kph) and four types of seeds (tomatoes, onions, radishes and lettuce). Dependent variables were the seed's lateral dispersion coefficient compared to the straight line, seed shedding rate per unit area. effect Percentage of metering device on seed viability, and breakage percentage of seeds after crossing the metering device. **Results:** The results showed that, the rate of seed shedding per hectare declines in all seeds along with increasing ground speed. However the lateral dispersion coefficient of the straight line planting has increasing trend along with increasing ground speed and the both parameters are lower in asphalt's substrate surface than the cultivated ground. breakage percentage of seeds and effect Percentage of metering device on the viability of seeds after passing through the planter are also very low. It assume that use of the planter in front of method of hand cultivation reduce some costs such as costs of seed's purchase.

1.INTRODUCTION

The area under cultivation of vegetables has fourth rank in Iran. Vegetables are in third rank by amount produced. About the ratio of the produced amount to area under cultivation (30.64), first rank devotes to vegetables. More than half of the vegetable's area under cultivation in the country is in seven provinces of Khuzestan, Fars, Hormozgan, Kerman, Hamedan, Zanjan, Golestan. Among them, Khuzestan has 71077 hectares and 12.73% of the total cultivated area and the first rank devotes to it for produced amount and cultivated area (anonymous, 2011).

Various stages of production to consumption of vegetables and oilseeds are very difficult and sensitive as compared to other products such as cereals. Vegetable seeding is the hardest and most critical step in to produce these products because of their sensitivity to distribution uniformity on the rows and control of proper depth in seed planting, (ZakiDizaji, 2003). In hand broadcasting of vegetable's seed, farmers have to raise their sowing density to achieve the desired crop density and high-performance. Also that increases use of inputs and creating more competition between plants also leads to the need for thinning in growing step. It's a notable cost. Rate of seed consumption per unit area is reduced in linear seeding compared to hand broadcasting. In linear seeding, seeds are placed in the soil at a certain and a uniform depth. Finally, in linear seeding, growing operations such as irrigation, crust breaking, weeding, soiling plant, spraying and fertilizing, etc. is better and easier than others (Mazaheri and Majnoon Hosseini,

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2005). Other researchers such as Azadshahraki (2002), Wayne et al (1997), Sing and Pariyar (1992), Rahmati and Haji Ahmad (2007), Wilkins (1979) have reached similar conclusions in their assessments. Also many researchers had works on the drill planters and comparing their performance with other methods. AfzaliNia (1998) compared a pneumatic planter with a common mechanical planter for tomato cultivation, and concluded that mechanical planter was better about seed emergence criteria and seed distribution uniformity. For the percentage of seed breakage, no appearance breakage was found in the seeds coming from tube of two planters. Heege (1993) compared several methods for planting grains, vegetables and legumes. Planting methods were as follows: linear seeding, broadcast seeding, band seeding, precision planter (control on sowing depth and spacing of seeds). In this study, spreading seeds per unit area was compared by these methods. Spreading seeds per unit area compared by using the average distance from each seed to beside seed in all directions. The evaluation revealed that best distribution of seeds per unit area is achieved through Broadcasting.

By considering a wide cultivation of vegetables in Khuzestan region, the aim of this study was to evaluate the locally made mechanical planter for cultivating vegetables in Khuzestan.

2. MATERIALS AND METHODS

In this study, the tests were conducted on the workshop campus of Shahid Chamran University of Ahvaz. Independent variables were the two types of substrate surface (asphalt and plowed field), three ground speed (3, 5 and 7 kph) and four types of seeds (tomatoes, onions, radishes and lettuce) (Table. 2). Dependent variables included the seed's lateral dispersion coefficient compared to the straight line, seed shedding rate per unit area, effect Percentage of metering device on seed viability, and breakage Percentage of seeds after crossing the metering device. To evaluate the seed's lateral dispersion coefficient compared to the straight line and seed shedding rate per unit area used a Split-Split-Plot Design. To evaluate the effect Percentage of metering device on seed viability and breakage Percentage of seed used a Randomized Complete Block Split-Plot Design with three replications. The statistical analysis carried out by MSTATC software.

The planter is made by Sanatkaran Company in Dezful city, Khuzestan. In recent years, the planter is used in many cities of Khuzestan, of Iran, and even in some of the neighboring countries for vegetable seeding and it has welcomed by many vegetable farmers. The planter has a mechanical seed metering device in the roller shape. Nine small brushes surrounds the seed metering device which sweep seeds out of the tank and put in front of an opening in the tank wall. Then the seeds pass through a seed plate which has outlets in different diameters depending on the seed type and seed size. The seeds placed in the soil after passing through the Dropper tube and furrow opener. An overview and various parts of the machine show in Figure. 1.

Table 1.

specifications seeds used

Lettuce	Radishes	Onions	Tomatoes	Type of seed
Paris Island	Italian Chrybl	Texas Early Grano 502 Delta Netherlands	C-H Falat	**sort and manufacturer**
99	99	99	99	**Purity (%)**
311	681	379	373	**Density (kg / m3)**
7.4	5.4	7.4	6.4	**Moisture (%)**
Length: 8.1 Width: 4 thickness: 0.2	Length: 3.6 thickness: 2.2	Length: 2.8 Width: 1.8 thickness: 1	Length: 3.13 Width: 2.42 thickness: 0.5	**Dimensions (mm)**
1.04	14.35	4.054	2.28	**Seed weight (gr)**
Long	Quasi-spherical	Erratic	Flat	**Grain shape**

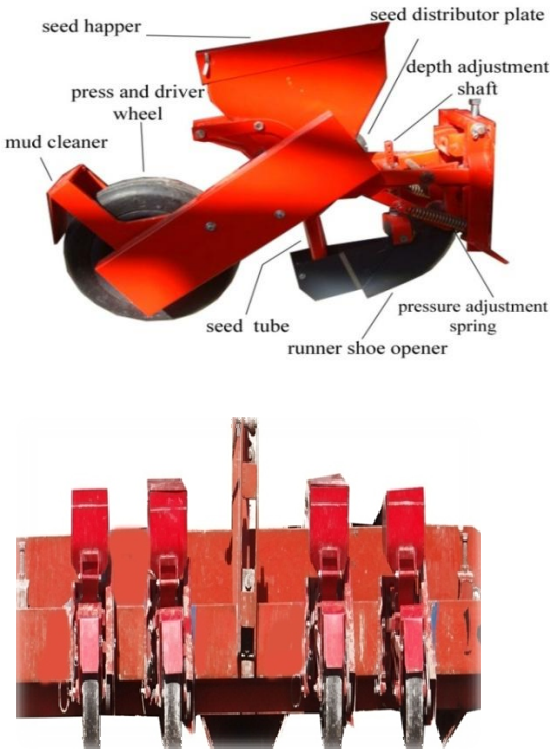

Fig.1. An overview and various parts of unit sanatkaran dezfule drill.

2.1. The method of measuring

The test of seed's lateral dispersion coefficient compared to the straight line on the asphalt, in this case, was that the label strip (width of 20 cm) at a distance of 20 meters placed under the planter units. The seeds fall on the ground and attaching on labels without any movement and their positions do not change when passing the machine (Fig. 2. right). It is worth mentioning that press wheel locate at back of the planter and it is the seed metering device driver. With a small change, the press wheel moved to aside planter unit, so during movement, it did not adhere to the tape label. Works of preparing the land for planting vegetables performed by the plow, disk and trowel to prepare a second substrate (plowed). To keep the seed positions on the ground during the test, ground wetted down at the intended distance and width just as the underside of each unit planting. Thus the land was sticky and the seeds stuck on the wet field without shifting the crash site after the fall of the each unit (Fig. 2. left). The irrigation performed in a manner that wheels of the planter did not move on the wet bar to the wheels don't slip and to don't change the uniform distribution of the seeds.

Fig. 2. Images of the distance from the seeds on the label and plowed bed

A yarn placed at the path of the machine and the trajectory of furrow opener to measure seed's lateral dispersion coefficient compared to the straight line at planter (Figure 2, left). Then transverse distance between the yarn (straight line) and all the seeds available measured using a ruler at one meter. Lateral dispersion of the seeds compared with the mean calculated using the Senapati formula (Senapati et al., 1992). To measure the rate of seed shedding, the planter was moving with intended speed at a certain distance. These seeds poured down from dropper tube each planter unit in each speeds, and they collected by a plastic bag that attached to the end of each unit of the furrow opener. Then collected seeds.

A yarn placed at the path of the machine and the trajectory of furrow opener to measure seed's lateral dispersion coefficient compared to the straight line at planter (Figure 2, left). Then transverse distance between the yarn (straight line) and all the seeds available measured using a ruler at one meter. Lateral dispersion of the seeds compared with the mean calculated using the Senapati formula (Senapati et al., 1992). To measure the rate of seed shedding, the planter was moving with intended speed at a certain distance. These seeds poured down from dropper tube each planter unit in each speeds, and they collected by a plastic bag that attached to the end of each unit of the furrow opener. Then collected seeds *w*eighed by an accurate digital scale. To measure the breakage percentage of seeds, at first 200 grams seed separated and weighed from each of the groups. Then these seed carefully cleaned by hand. The seeds transferred to the tank of each planter unit. These seeds poured down from dropper tube each planter unit

in intended speeds and they collected by a plastic bag that attached to the end of each unit of the dropper tube. The broken, crushed, scraped and naked seeds and the total collected seeds counted. The total breakage percentage of the seeds for each planter calculated by the following equation.

$$D = \frac{X \times 100}{Y} \quad (1)$$

Where: D is Breakage percentage of seeds

X is damaged number of seeds; Y is total number of seeds out of seed metering device

To determine the seed viability after passing through planter, fifty seeds isolated randomly from samples coming from the planter in breakage test, in desired speed of each repetition. These samples planted by hand on germination trays with a proper distance. Then the seeds placed in a germination chamber according to the required temperature for intended plant and time of germination tests determined by International Seed Testing Association (Ista) (Ista, 2011). Percentage germination calculated by dividing number of the germinated seeds to total number of the seeds.

3. RESULTS AND DISCUSSION

The variance analysis results of the planter show in Tables 3 and 4. About seed shedding per hectare, the interaction between substrate type, ground speed and seed type, according to the Compare Means Test -Duncan diagram in Fig. 3, the seed shedding per hectare reduced with increasing speed. Since with increasing speed, the Wheel Slip of the planter's carrier increases and the seed shedding per hectare decreases. In each substrate, separately highest amount of shedding at one hectare related to radish seed at a speed 3 kph. In each substrate, separately lowest amount of shedding at one hectare related to lettuce seed at a speed of 7 kph. The obtained results are consistent with the results of other investigators, including Wilkins (1979) for row crops, Rahmati and Haji Ahmad (2007) for tomato seeds. Also, as it shows in Fig. 4, in the tomato seeds there was no significant difference between 3 and 5 kph speeds on asphalt substrate and, 5 and 7 kph speeds on plowed substrate. In the onion seed there was no significant differences between 3 kph speed on the asphalt substrate (on the label) and speed of 5 kph on the plowed substrate. In the onion seed also there was no significant differences between 7 kph speed on the asphalt substrate (on the label) and speed of 7 kph on the plowed substrate. In the radish seed there was no significant differences between 3 kph speed on the asphalt substrate (on the label) and speed of 5 kph on the plowed substrate. In the lettuce seed there were no significant differences between 3, 5 and 7 kph speeds on the asphalt substrate (on the label) and speeds of 5 and 7 kph on the plowed substrate. In the lettuce seed also there were no significant differences between 5 kph speed on the asphalt substrate (on the label) and speeds of 3 and 5 kph on the plowed substrate.

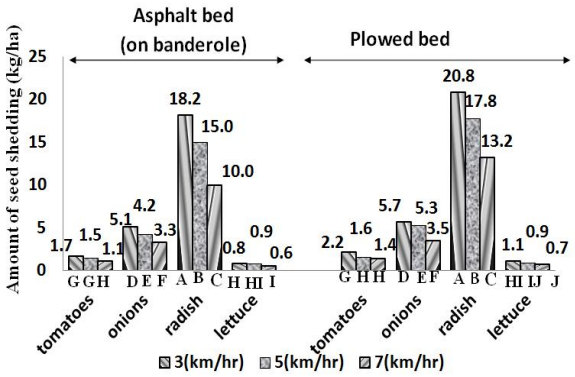

Fig.3. Comparison amount of seed shedding index at different levels of substrate, ground speed and type of seed

Table 2.

Comparison of two methods cultivation of vegetables, hand planting and cultivation using Sanatkaran planter

The average cost seed (RS/kg)	seed consumption using sanatkaran planter (kg/ha)			seed consumption in handy method (kg/ha)	Type of seed
	Speed 7 km/hr	Speed 5 km/hr	Speed 3 km/hr		
120000	1.2	1.5	1.9	4-5	Tomatoes
180000	3.4	4.8	5.4	6-8	Onion
160000	0.66	0.88	0.96	2	lettuce
45000	11.6	16.5	19.5	25	Radish

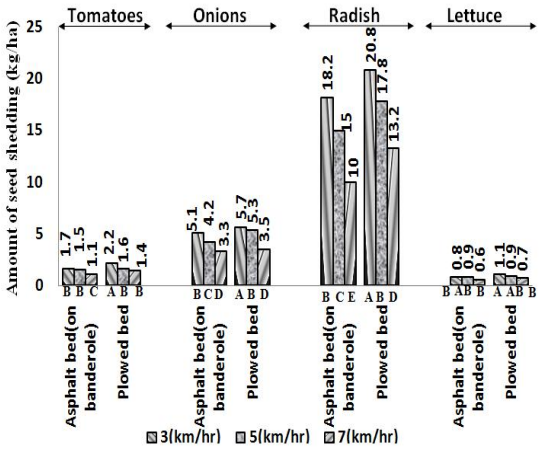

Fig. 4. Comparison amount of seed shedding index at different levels of substrate (Interactions of Three)

Seed consumption in two types of cultivation i.e. cultivation using Sanatkaran planter and handy method of vegetable planting are compared in Table. 2. The seed cost reduced greatly by Sanatkaran planter, and the earned results are consistent with other researchers such as Mazaheri and Majnoon Hosseini (2005), Azadshahraky (2002), Sing and Pariyar (1992).

About the seed's lateral dispersion coefficient compared to the straight line, the interaction between substrate and seed, it found that lateral dispersion of seeds is more in the plowed substrate than asphalt substrate. This is because of surface roughness and the shakes and the vibrations of the planter units and the hit of seeds with rugged topography during shedding. Comparative results present in Fig. 5 by Duncan test. In total, highest the seed's lateral dispersion coefficient compared to the straight line related to radish seed in plowed substrate. The lowest lateral dispersion coefficient related to lettuce seed on asphalt substrate and separately in each substrate is the same case. This is because of the greater weight of radish seed than others and its round shape which result in throwing the seeds to around of straight line and increasing the dispersion coefficient.

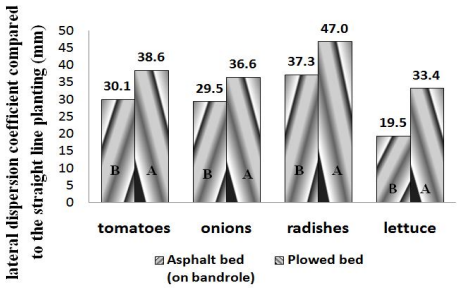

Fig. 5. Comparison of lateral dispersion coefficient compared to the straight line planting in different levels of substrate and the type of seed

The interaction between the substrate and ground speed determined by comparing means, as is shown with capital letters on Fig. 6. lateral dispersion coefficient compared to the straight line increases with increasing ground speed in each substrate. And as lowercase letters show in the diagram, lateral dispersion coefficient compared to the straight line in plowed substrate is more than asphalt substrate. The lateral dispersion of seeds is more in the plowed substrate than asphalt substrate. This is because of surface roughness and the shakes and the vibrations of the planter units and the hit of seeds with rugged topography during shedding. Also with increasing speed, seeds fall rapidly and throwing around of straight line and they are not uniform on a line.

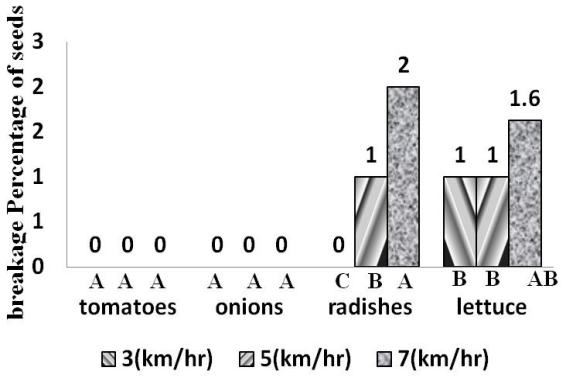

Fig. 7. Comparison Breakage percentage of seeds at different levels of types of seed and ground speed

In effect Percentage of metering device on seed viability, the interaction between seed type and ground speed, there is no significant difference between 3 and 5 k ph speeds in lettuce seed. But between these speeds and the 7 k ph speed, the differences are significant. There are significant differences between all three speeds in radish seed. In tomato and onion seeds there are no significant differences between intended speeds and the effect Percentage of metering device on seed viability is zero. In sum of all the treatments, the highest effect Percentage of metering device on seed viability related to lettuce seed in 7 k ph speed. The lowest effect Percentage of metering device on seed viability relates to onion and tomato seeds and there are no significant differences between the different speeds. Also radish seeds have no significant difference with them in 3 k ph speed. The effect Percentage of metering device on the lettuce seed viability is greater than others because injuries and breaks during leaving the planter are more than others. The comparisons of means show in Figure. 8 by Duncan Test.

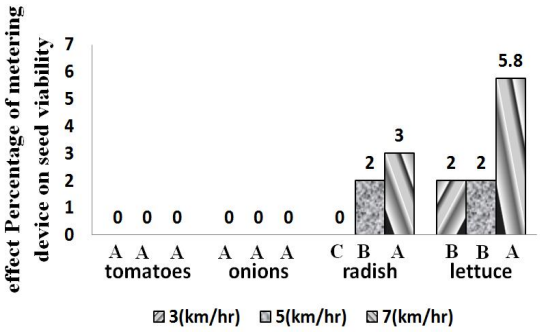

Fig.8. Comparison of the effect Percentage of metering device on seed viability at different levels of types of seed and ground speed

Table 3.

The variance analysis results for the traits in sanatkaran planter (F value)

Sources of change	Degrees of freedom	amount seed shedding per hectare index	lateral dispersion coefficient compared to the straight line planting index
Repeat	2	0.02^{ns}	0.41^{ns}
Work bed (a)	1	1518.50^{**}	36.8^{**}
Error (a)	2		
Seed type (b)	3	28720.65^{**}	63.64^{**}
Work bed × type of seed	3	243.6^{**}	3.32^{*}
Error (b)	12		
Ground speed (c)	2	2852.43^{**}	129.48^{**}
Work bed × Ground speed	2	0.18^{ns}	4.07^{**}
Ground speed × type of seed	6	1219.04^{**}	0.67^{ns}
Work bed × Ground speed× type of seed	6	10.47^{**}	0.22^{ns}
Error (c)	32		
The coefficient of variation (CV)		%2.19	%13.41

ns and * and **, respectively, insignificant and significant at 5% and 1%

Table 4.

The variance analysis results for the effects percentage metering device on viability of seed and Breakage percentage of seeds traits in sanatkaran planter (F value)

Sources of change	Degrees of freedom	effects percentage metering device on viability of seed	Breakage percentage of seeds after passing planters
Repeat	2	1^{ns}	0.47^{ns}
Seed type (a)	3	137^{**}	55.04^{**}
Error (a)	6		
Ground speed (b)	2	37^{**}	6.25^{**}
Ground speed × type of seed	6	17^{**}	13.54^{**}
Error (c)	16		
The coefficient of variation (CV)		%12.77	%13.14

ns and * and **, respectively, insignificant and significant at 5% and 1%

CONCLUSION

In general, the rate of seed shedding per hectare declines in all seeds along with increasing ground speed. However the lateral dispersion coefficient of the straight line planting has an increasing trend along with increasing ground speed and the both parameters are lower in asphalt's substrate surface than the cultivated ground. Percentages of breakage after passing through the planter and effect Percentage of metering device on seed viability are also very low. It assume that use of the planter reduce some costs such as costs of seed's purchase In comparison with hand planting method.

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