International Journal of Food, Agriculture and Veterinary Sciences ISSN: 2277-209X (Online)
An Online International Journal Available at http://www.cibtech.org/jfav.htm
2012 Vol. 2 (2) April-June, pp.74-86/Nazarialam et al.

Research Article

BIOLOGY, PHENOLOGY AND INTERFERENCE OF GROUND CHERRY (*PHYSALIS DIVARICATA*)

*** J. Nazarialam[1], H. Amiri[2], S.Shahbazi[1], M. Dastoori[3] and Hesam Esmaeilnejadte Imouradabi[4]**

[1] Department of Agronomy and Plant Breeding, University of Tehran
[2]Department of Agriculture, Payame Noor University, PO Box 19395-3697, Tehran, Iran
[3]Department of Agronomy, Faculty of Agriculture, Islamic Azad University, Shiraz, Iran
[4]Agriculture Research Center, Karaj Branch, Islamic Azad University, Karaj, Iran
[*]Author for Correspondence

ABSTRACT

Physalis divaricata is one of the most important weeds in summer crops in Lorestsn province. The purpose of this study was to evaluate the Biology of *Physalis divaricata* including seeds dormancy in different month at two levels (0 and 10 cm soil), photoblastic reaction and initial incision effect the viability of immature seeds. Also, phenology based on GDD and morphology Characteristics of *Physalis divaricata* were assayed compared to sugar beet crop. The neighboring effect of *Physalis divaricata* calculated upon individual plants of sugar beet sown at a distance of 125 cm. Results showed that majority of seeds of *Physalis divaricata* have no dormancy and seed germination in soil surface and 10 cm depth was 88 0/0 from October to May. Germination showed statistically no significant difference in both light and dark conditions (99 and 97 %, respectively). Fresh seeds had higher than 99 % germination. Also, it possessed slow growth in wheat and alfalfa crops and produced less than two berries at individual plant. Nevertheless upon initial incision, the germination of *Physalis divaricata* seeds increased up to 56 % after one week of incision. *Physalis divaricata* caused a 20% damage to sugar beet at a density of 1 plant m^{-2}. This weed imposed negative effects upon individual plant of sugar beet at distance of 50 cm. furthermore, results indicated that to arrive flowering stage, *Physalis divaricata* necessary 61/45 -75 GDD and is day-neutral weed.

Key Words: *Phenology, Photoblastic, Germination, GDD (Growth Degree Day)*

INTRODUCTION

Predictions of plant development in growth models is profitably based on the accumulation of heat units or degree-days (Frank and Ries, 1990; Fidanza *et al.*, 1996). An equation was fitted between green foxtail

Research Article

Seedling height and degree-days to optimize the timing of management operations (Forcella and Banken, 1996). Plants show largely different in their growth and phonological behavior. Such differences is partly related to the natural traits of species (Grime and Hunt, 1975). Many studies have revealed the plant traits clarifying growth and phenology variation, such as physiology (Walters *et al.,* 1993), morphology (Cornelissen *et al.,* 1996), and anatomy (van Arendonk and Poorter, 1994). Phenology is a critical factor determining competition between crop and weed, and temperature and photoperiod are two important environmental factors influencing phenological development (Major and Kiniry, 1991; Patterson, 1993; Ghersaand Holt, 1995). Recent studies have shown that a highly uniform pattern of crop plants suppresses weeds 30% better on average than plants distributed in standard 12 cm rows, and that further improvements in weed suppression can be achieved by also increasing crop density (Weiner *et al.,* 2001; Olsen *et al.,* 2005, in press). Reduced yields, improper root formation, and interference with harvest operations were reported as a result of weed presence in sugar beet (Bell *et al.,* 2000; Bellinder *et al.,* 1997). Weeds have become a problematic issue in the sugarbeet cultivation (Longden, 1993). The size of individual plants within a stand can vary greatly. According to Harper (1977) plant population often develops a size hierarchy with a few large dominants and many suppressed individuals (Harper, 1977). Weiner (1990) found that Competition between plants can vary from asymmetric to symmetric because survivorship and fecundity tend to correlate closely with the size of the plant (e.g. Solbrig, 1981). under completely asymmetric competition, small plants induce no effect on the growth of a larger plant, but large plants have negative effects on the growth of smaller plants. Also, in absolutely symmetric competition, plant growth is reduced under neighbours interference, regardless of neighbouring plant size. Competition is asymmetric when light limits growth, but is symmetric when water and mineral nutrients limit growth (Thomas and Weiner, 1989). In no area of ecology is the role of space more fundamental than in the study of plant communities (Hutchings 1986; Crawley and May 1987). According to Eriksson (1986) individual plants are rooted in one place and their ability to move and occupy space is related to their growth. Time of emergence and the number of established individuals can have determinant role as a function of environmental factors controling germination (mainly temperature and water availability) (Vleeshouwers, 1997; Batlla and Benech-Arnold, 2004). However, the predicting time and percentage of emergence in weed species is difficult due to the usual presence of dormancy (Benech-Arnold and Sa´ nchez, 1995). This is because in many weeds the number of established seedlings is strongly related to the dormancy level of the seed bank, and the timing of emergence depends largely on the seasonal dynamic variation in seed bank dormancy (Benech-Arnold et al, 2000). The objective of this study is to demonstrate the biology and morphology of *Physalis divaricata* weed that is not known anywhere.

Research Article

MATERIALS AND METHODS

Morphology And Phenologyparticulars

Field experiments were conducted in Alashtar(35^0 $52^/$ N, 48 ^{0} 12 $^/$ E), Iran in 2007, with maximum and minimum annual temperature of 45^0 c and -15 ^{0} c , average annual precipitation of 525 mm and elevation 1580 m. The soil type was loam. Ten sugar beet, alfalfa and wheat fields were selected at late season and 20 plants of *Physalis divaricata* were selected and length, dry weight, number of berry and number of seed in the berry of individual plant was calculated. Also phenology of *Physalis divaricata* was calculated with selection of 8 plants at 2 sugar beet fields and their growth stage was completely registered based on GDD from seedling to seeds formation. To determine phenological and growth stages of a weed there are 6 indices being (1-seedling. 2-juvenile. 3-flower bud. 4-flowering. 5-fruiting. 6- Seed disperse).

Density, Damage And Neighboring Effect

Interference effects of *Physalis divaricata* were evaluated on sugar beet crop. Treatments were weed density (0, 1, 2, 4, 8, and 16 plant m^{-2}) at the sugar beet rows. *Physalis divaricata* Seeds were sown at the distance of 10 cm from the sugar beet rows. Each experimental plot consisted of four rows 5 m long. Experiment was established in a randomized completely blocks with 4 replications. To enter neighboring effect, one seed of *Physalis divaricata* was sown to the nearest plant at the sugar beet rows and the rest plants were sown at the distance of 25, 50, 75, 100 and 124 cm from weed seed (Berger and Hilden, 2000). In late season sugar beet yield was calculated at a distance of 125 cm. To determine density of weed 30 fields were selected and so sampled 5 systematic sampling of 1 m^{-2}.

Seeds Dormancy And Photoblastic

To survey seeds dormancy, seeds were laid in 2 depths (0 and 10 cm) after spurring in autumn. Then, seeds were placed in penetrable plastic purses. Rate of seeds germination was calculated monthly from October to May. This experiment was in a factorial (2*8) base on randomized completely design with 3 replication. Factors were included 1) the depth effect at two levels (0 and 10 cm soil), 2) time effect at eight levels (October to May). To evaluate the photoblastic effect upon germination, seeds of *Physalis divaricata* placed in Petridishs coverd with two aluminum layers to avoid light penetration and then placed into growth chamber with 30 c ^{0}.

Initial Incision Effects Upon Immature Seeds

The number of *Physalis divaricata* plant was cut during early stages of flower formation. Prior to cutting, the seeds on the plants were sampled, calculated their germination rate after one week and they were compared together. In order to estimate the germination capacity, seeds of *Physalis divaricata* were set on two Whatman No. 2 filter papers in with 9-cm-diam Petri dishes, and 3 milliliter of distilled water was

Research Article

placed in each petri-dish. All petri- dishes were placed in an incubator with a constant temperature of 30 C and relative humidity 60%, corresponding to the optimal temperature for germination of *Physalis divaricata* seeds (Mousavi and et al., 2008). Seeds were germinated under conditions of continuous dark (wrapped in Aluminum foil). Again growth and ability of seeds of this weed was measured after one month.

RESULTS AND DISCUSSION

Morphological And Phenological Characteristics

Physalis divaricata produced abundant seed and growth in sugar beet fields, so that its average height and width was 70 cm, in contrast, it showed stunt growth in alfalfa and wheat and produced less than 130 and 210 seeds, respectively. Some individual plants of *Physalis divaricata* were able to produce 44 thousand seeds and 120 cm in sugar beet (Table1). Means of horizontal development and penetration depth of *Physalis divaricata* root was 30.69 and 19.48 cm, respectively. Also, means of *Physalis divaricata* dry weight and berry dry weight was 173.3 g plant^{-1} and 54 g plant^{-1}, respectively. This showed that more photosynthesis material allocated to the production of seed.

Table 1: Compare of specialists of ground cherry weed in different crops.

Special	Wheat	Alfalfa	Sugar beet
Number of berry	1.3	1.2	62.418
Number of seed	130	210	44000
Number of leaf	7.57	5.15	Abundant
Number of branch	13.45	9.3	Abundant
Height (cm)	92.15	4.31	6.71
High of root	45.11	-	48.19

Phenology Based On Gdd

Flowering stage of ground cherry coincided with a range 61.45–75 (GDD), its juvenile stage was observed with 49.8-55 GDD (Fig 1). Its emergence period to first appearance of ground cherry fruits occurred with 186.3- 199.5 GDD. Also, of ground cherry seed dispersal corresponded to a 454.15 GDD. The first appearance of ground cherry berry coincided with a range 186.3–199.5 GDD. Furthermore, 3 and 4 growth index stages of ground cherry, which are juvenile and flowering stages, respectively, matched with 61.45-75 GDD. Ground cherry flowering stage continued to the late season, indicating light had no effect on ground cherry.

Research Article

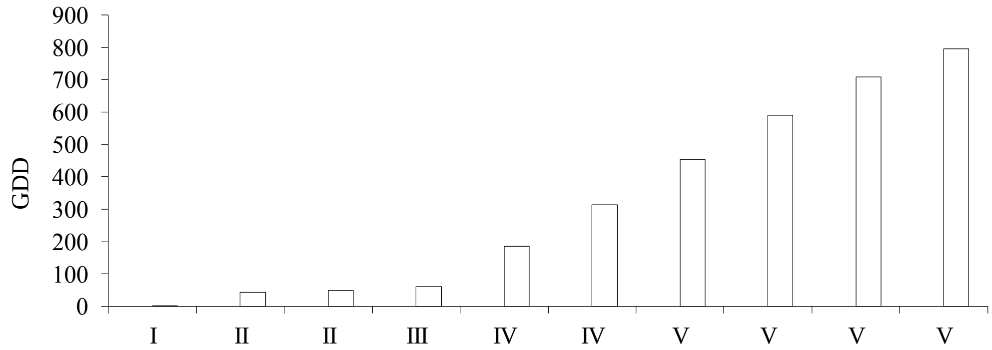

Figure 1: Growth stage of ground cherry based growth index. (I = sidling. II = juvenile. III = flower bud-flowering. IV = flower bud – flowering- fruiting. V = flower bud –flowering - fruiting -Seed disperse).

The flower bud and flowering stages of ground cherry corresponded to 10 -9 leaf stage of sugar beet and continued to autumn season, demonstrating ground cherry is a neutralized weed to the long day (table 2). This weed needs many GDD to pass the flowering to fruiting stages and this is the reason that it can be produced more flowers. This issue is probably one of the most strategies to produce seed of them. Indeed, ground cherry was produced so much shoot prior to berry production. The berries formed one week after flower formation. Also, the drooping of ground cherry berries occurred from first half of August but the majority of berries remained on plant by the end of growing season.

Density, Damage And Neighbor Effect

Density of *Physalis divaricata* in sugar beet farms was 2.05 plants (m^{-2}) in Alashtar County (Table 3), although, in some farms it was 8 plants (m^{-2}). This weed at the density of 2.09 plants m^{-2} caused 34.07 % yield loss in sugar beet farms.

Imposed damage will be interoperated with regard to the characteristics and size of *Physalis divaricata*. A reduction of 18/76 % of sugar beet yield was observed as a result of increasing weed density from 0 to 16 plants m^{-2} (Figure 2).

Furthermore, sugarbeet yield was drooped 21.81 % at the density of 1 plant m^{-2}. Our results are concurrence with previous results (Harcker, 2007) based on decreasing of a 20 % crops yield loss at the density 1 of the annual weed. In some farms, ground cherry was appeared at the density of 8 plants m^{-2} so that caused 70.83 % damage, so given this weed is necessary. A sharp slope of the curve of sugarbeet percent yield loss was detected at low density, whereas, at higher densities was observed the slowly one (Figure 2). Means comparison of sugar beet yield (LSD=0.05), showed that no statistically significant

Research Article

Table 2: Phenology of ground cherry on base GDD and growth index in compare with sugar beet crop (growth index include: 1-seedling. 2-juvenile. 3-flower bud. 4-flowering. 5-fruiting. 6-Seed disperse).

Growth index	Growth stage of *Physalis divaricata*	Growth stage of sugar beet	GDD	Date
1	Seedling	Cotyledon to2 real leaf	2	First half of May
2	Juvenile	3-4 real leaf	43.7	Second half May
2	Juvenile	5-6 real leaf	49.8-55	First half of June
3-4	Bud flower, flowering	9-10 real leaf	61.45-75	Second half June
3-4-5	Bud flower, flowering, fruiting	13-14 real leaf	186.3-199.5	First half of July
3-4-5	Bud flower, flowering, fruiting, dispersal	14-15 real leaf	314.65-325	Second half July
3-4-5-6	Bud flower, flowering, fruiting, dispersal	15-16 real leaf	454.15	First half August
3-4-5-6	Bud flower, flowering, fruiting, dispersal	15-16 real leaf	589.95	Second half of August
	Bud flower, flowering, fruiting, dispersal	15-16 real leaf	708.45	
3-4-5-6				First half of September
	Bud flower, flowering, fruiting, dispersal	15-16 real leaf	795.95	Second half of September
3-4-5-6				
3-4-5-6	Bud flower, flowering, fruiting, dispersal	15-16 real leaf	-	First half of October
	Dead		-	Second half of October

GDD, growth degree day

Research Article

Table 3: Weed density (m^2)in sugar beet farms in Alashtar County.

Species	Weed density (m-^{2})
Physalis divaricata	2.05
Hibiscus sp.	1.67
Convolvulus arvensis	1.36
Sorghum halepens	0.87
Setaria viridis	0.75
Chenopodium album	0.49
Amaranthus sp.	0.45
Portulaca oleracea	0.24
Saideretis sp.	0.23
Solanum nigrum	0.23
Rhaphanus raphanistrum.	0.09
Cuscuta sp.	0.04
Xanthium sp.	0.04
Cardaria draba.	0.03

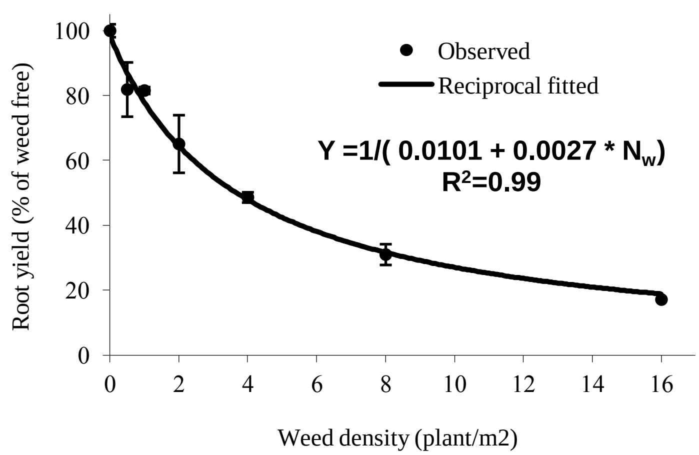

Figure 2: Yield loss of sugar beet in different weed density of ground cherry.

difference was observed between 8 and 16 plants m^{-2} due to intra-species competition (table 4). There was significant difference between 0.5 plants m^{-2} as compared to control and % of its damage was 18.12.

Table 4: Damage of ground cherry in sugar beet crop (%). Means within each column sharing the same letter(s) are not significantly different based on LSD test atp = 0.05.

Weed density (plants m^{-2})	Mean of yield (kg h^{-1})	Damage (%)
0	52080 a	0
0.5	41820 b	12.18
1	41000 b	21.81
2	33000 c	07.43
4	24830 d	51.76
8	15830 e	70.63
16	8750 e	70.83

Neighbor Effect

The *Physalis divaricata* L. imposed significant effects upon single plant of sugar beet at a distance of 50 cm and caused a % 6.42 yield loss (Figure 3). At the closest distance of sugar beet plant occurred 41.7 0/0 yield reduction. Also, no significant effect caused at a distances of 50-100 cm upon the sugar beet plant as a result of ground cherry presence. Kochinda (2001) founds, also, that neighbor effect decreased with increasing the distance from single plant. Single plant of *Physalis divaricata* possessed large size and so imposed critical effects on closer sugarbeet. The yield of single plant was constant after 100 cm of distance crop (Figure 3).

Seed Dormancy

Seeds of ground cherry are surrounded by berry which prevents their germination after falling in the autumn that is called the physical dormancy of seeds (Balesteri and Sinneli 2004). The berries is decompose by environment factors in the autumn and winter season and seeds coat decay approximately in early spring and seeds fall into the soil and ready to germinate. Germination test showed that seeds of ground cherry have on dormancy during the autumn and winter seasons after dropping (Figure 4). Battela and *et al.,* (2007) found that low dormancy level is a specification for germinated in spread range of environment condition. Means comparison showed that the most germination percentage of ground cherry was happened in subsoil seeds with 97 % in May and December and the least germination was in soil surface with 88 % in January (Fig 4).

Seeds placed at subsoil probably less exposed to environmental fluctuations and a percentage of seeds become dormant. According to study of Batela and *et al.,* (2007) seeds with the less environmental stress have the less germination. Seeds located at soil surface show more germination; however, no significant differences were between effects buried depths of seeds. Based on the results, seeds of ground cherry

Research Article

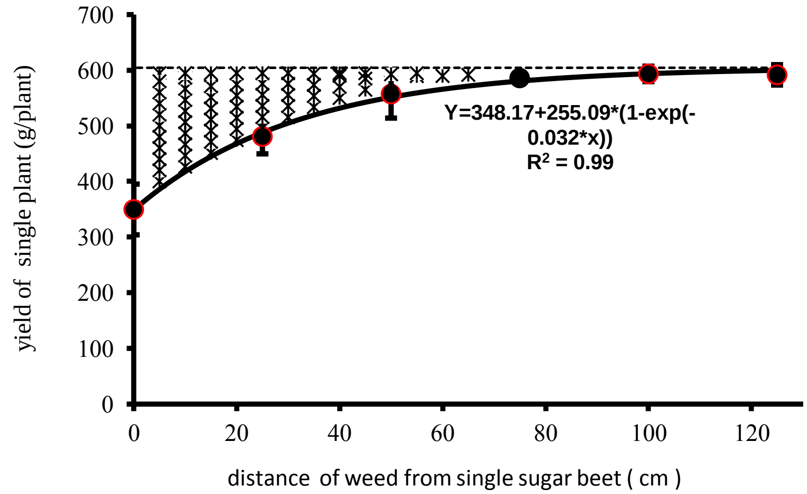

Figure 3: Neighbor effect the single ground cherry on single plant of sugar beet.

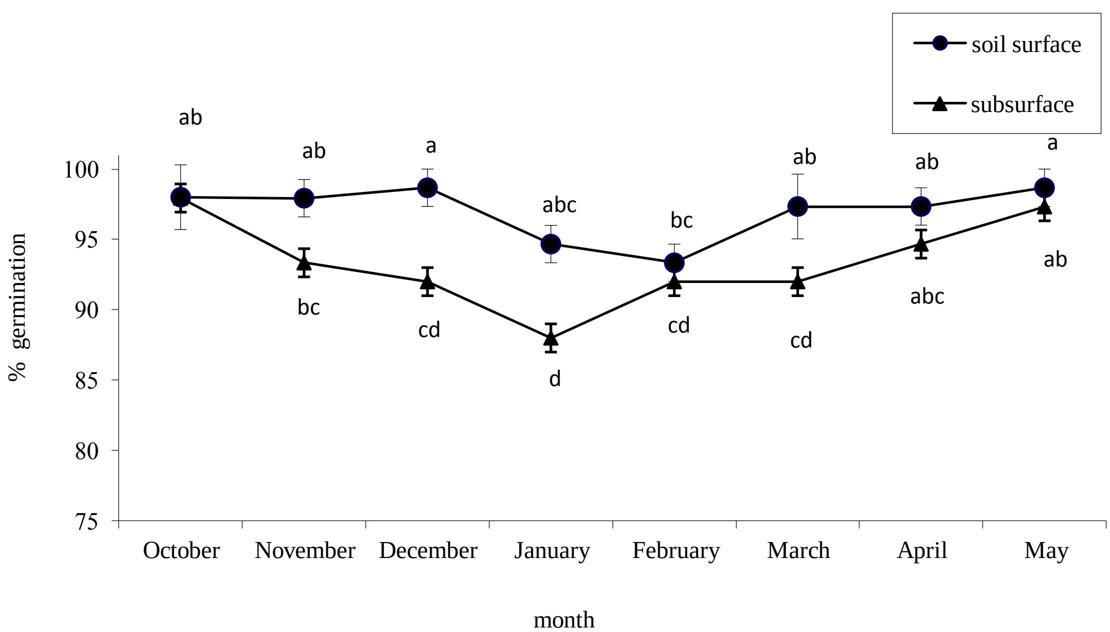

Figure 4. Germination percentage of ground cherry in different months at two levels (0, 10 cm) of soil (I= error standard and means the same letter (s) are not significantly different based on LSD test at p=0.05.

were free of dormancy, which can help to management and control of this weed using fallow and alternation. Under laboratory conditions, the least germination occurred on January and an increasing

Research Article

trend of germination was observed to May (Figure 5). According to Anderson and Milberg (1998) Seeds of weed have mechanism for maximum germination under suitable environment condition.

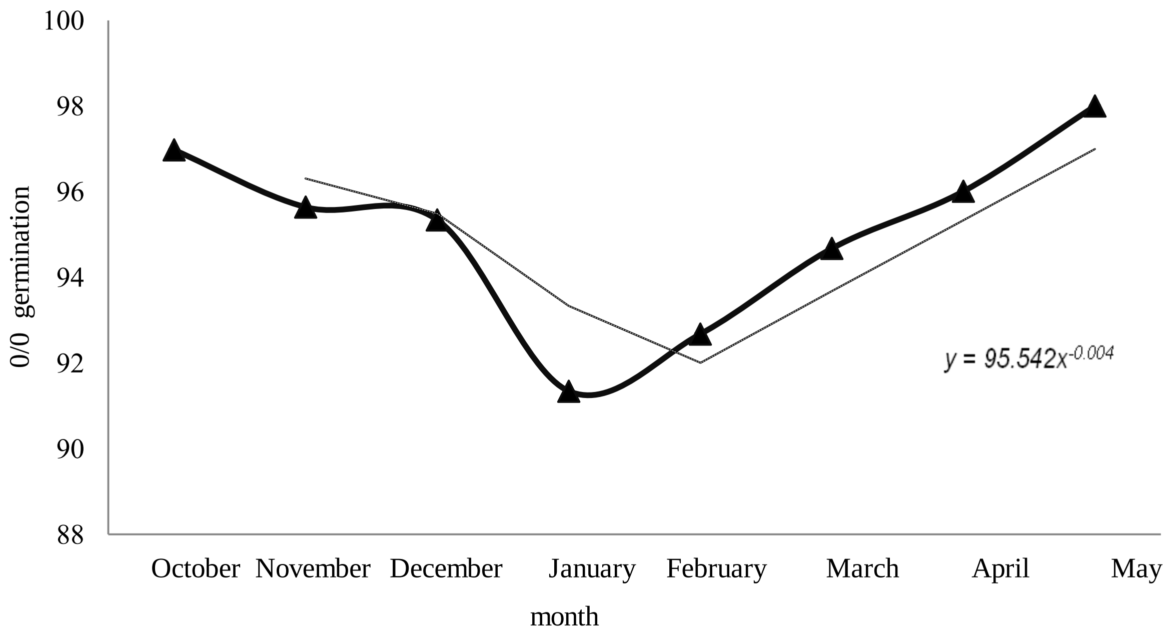

Figure 5. means of seeds germination of ground cherry at different months

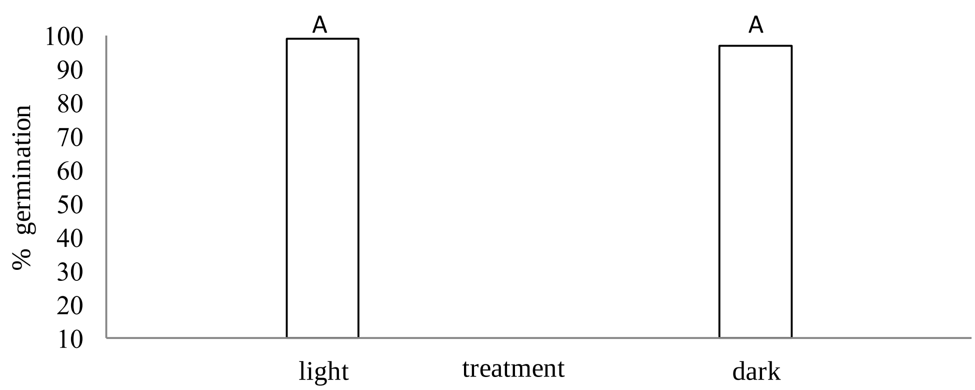

Figure 6. germination of ground cherry in two light and dark condition (%). Means with the same letters re not significantly different based on LSD test atp = 0.05

Photoblastic Reaction

The *Physalis divaricata* have small seeds so that 1000-seed weight is 1 g, nevertheless, they do not require light to germinate. There was no significant difference ($P < 0.05$) between the germination percent

Research Article

of *Physalis divaricata* at light and dark conditions (99 and 97 %, respectively) (Figure 6). Lack of light requirement for germination at *Physalis divaricata* can be ecologically harmful, because seeds buried too deeply of soil are able to germinate and consequence they disappear because of the lack of nutrients.

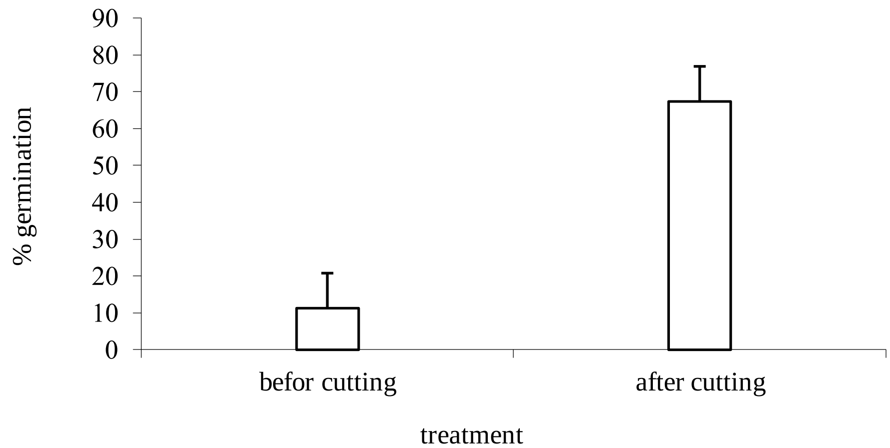

Figure 7: Comparision of germination (%) of ground cherry seeds before and one week after cutting (I= standard error).

Early Cutting Effects On Immature Seeds

Germination of seeds was 12 % during the flowering stage on time of plants cutting but it was more than 65 % germination after one week (Figure 7). In visual observant it was found that seeds had white color before cutting but seeds changed to purple color and become relatively hard one week after. Seed maturity is probably caused by Gelatin substrate surrounded seeds after one week cutting.

REFERENCES

Andersson L and Milberg P (1998). Variation in seed dormancy among mother plants, populations and years of seed collection. *Seed Science Research* **8**(1) 29–38.

Balestri E and Cinelli F (2004). Germination and Early-Seedling Establishment Capacity of Pancratiummaritimum L.(Amaryllidaceae) on Coastal Dunes in the North-Western Mediterranean. *Journal of Coastal Research* **20** (3) 761–770.

Batlla D, Roberto L and Benech A (2007). Predicting changes in dormancy level in weed seed soil banks: Implications for weed management. *Crop Protection* **26**(3)189–197.

Batlla D and Benech-Arnold RL (2004) Seed dormancy loss assessed by changes in population hydro time parameters. Development of a predictive model. *Seed Science Research* **14**(3) 277–286.

Bell CE, Boutwell BE, Ogbuchiekwe EJ and McGiffen ME (2000). Weed control in carrots: the efficacy and economic value oflinuron. *Hortscience* **35**(6) 1089–1091.

Bellinder RR, Kirkwyland JJ and Wallace RW (1997). Carrot (*Daucus carota*) and weed response to linuron and metribuzin applied at different crop stages. *Weed Technology* **11**(2) 235–240.

Benech-Arnold RL and Sa´ nchez RA (1995). Modeling weed seed germination. In: Kigel, J., Galili, G. (Eds.), *Seed Development and Germination*. New York: Marcel Dekker, 545–566.

Benech-Arnold RL, Sa´ nchez RA, Forcella F, Kruk BC and Ghersa CM (2000). Environmental control of dormancy in weed seed banks in soil. *Field Crops Research* **67**(2) 105–122.

Degrandi-Hoffman G, Thorp R, Loper G and Eisikowitch D (1996). Describing the progression of almond bloom using accumulated heat units. *Journal of Applied Ecology* **33**(4) 812–818.

Eriksson O (1986). Mobility and space capture in the stoloniferous plant Potentilla anserina. Oikos **46**(1) 82–87.

Fidanza MA, Dernoeden PH and Zang M (1996). Degree-days for predicting smooth crabgrass emergence in cool-season turfgrasses. *Crop Science* **36**(4) 990–996.

Frank AB and Ries RE (1990). Effect of soil water, nitrogen, and growing degree-days on morphological development of crested and western wheat-grass. *Journal Range Management* **43**(3) 257–260.

Ghersa CM and Holt JS (1995). Using phenology prediction in weed management: a review. *Weed Research* **35**(6) 461-470.

Harker KN and Robert E (2007). Wild Oat (Avena fatua) vs. Redstem Filaree (Erodium cicutarium) Interference in Dry Pea. *Weed Technology* **21**(1) 235–240.

Harper JL (1977). Population biology of plants. London: Academic Press.

Kuchinda NC (2001). The ejects of nitrogen and period of weed interference on the bre yield of kenaf (Hisbiscusc annabinus L.) in the northern Guinea Savanna of Nigeria. *Crop Protection* **20**(2) 229-235.

Longden PC (1993). Weed beet resurgence in 1993: the bolters return. *British Sugar Beet Review* **3**(1) 61.

Major DR and Kiniry JR (1991). Predicting day length effects on phenological processes. In: Hodges, T. (Ed.), Predicting Crop Phenology. CRC Press, Boca Raton, FL, 15-28.

Mousavi SK and Ahmadi A (2008). Environment factor effect on germination of seeds of ground cherry weed. Plant pathogen **76**(1) 10 – 30.

Olsen JM, Kristensen L, Weiner J and Griepentrog HW (2005). Increased density and spatial uniformity increases weed suppression by spring wheat (Triticum aestivum). *Weed Research* **45**(2) 316–321.

Research Article

Solbrig OT (1981). Studies on the population biology of the genus Viola. II. The effect of plant size on fitness in Viola sororia. *Evolution* **35**(6)1080-1093.

Thomas SC and Weiner J (1989). Including competitive asymmetry in measures of local interference in plant populations *Oecologia* **80**(3) 349–355.

Vleeshouwers LM (1997). Modelling weed emergence patterns. Ph.D. Thesis, Agricultural University, Wageningen, The Netherlands.

Weiner J, Stoll P, Muller-Landau H and Jasentuliyana A (2001). The effects of density, spatial pattern and competitive symmetry on size variation in simulated plant populations. *American Naturalist* **158**(4) 438–450.