The Bioscan 10(2): 651-654, 2015
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

STUDIES ON SEED GERMINATION IN PEACH (*PRUNUS PERSICA* L. BATSCH) ROOTSTOCK 'FLORDAGUARD'

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KEYWORDS
Peach
Flordaguard
GA_3
Thiourea
Kinetin

Received on :
08.01.2015

Accepted on :
13.05.2015

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ABSTRACT
The highest percent seed germination (57.26), height (130.56 cm), girth (0.57cm), number of seedlings ready for grafting (46.53) and minimum duration of seed germination (16.33), mortality rate (1.9) was recorded in the scarification treatment. Irrespective of the treatments the maximum percent seed germination (22.57) , number of seedlings ready for grafting (16.68) was recorded when seeds were sown on 15th December and height (84.96 cm), girth (0.42 cm) was recorded when seeds were sown on 25th December and minimum duration of seed germination (23.62) was also recorded on 25th December. The present study revealed that vegetative parameters in terms of height, girth and number of leaves of the seedlings and root growth and survival percentage of the seedlings at the end of the experiment was found maximum when the seeds were sown after scarification on 25th December. All the growth regulators were not found to be effective for improving seed germination in peach rootstock 'Flordaguard'.

INTRODUCTION

Peach (*Prunus persica* (L.) Batsch) is believed to be the native of China. The fruit hasYellow and white flesh, a delicate aroma and velvety skin in some cultivars. In Japan, peach is among the leading fruits. The world production of stone fruit is estimated to be about 25 million tonnes per annum.Out of which peach contributes 13,757million tonnes. In India, the introduction of sub-tropical peach started in 1968, though the temperate varieties were alreadyunder cultivation in J and K, H.P and U.P (Nijjar, 1977). *Prunus* belongs to sub- family *Prunoidae* of family *Rosaceae*, which includes several species producing edible drupes of economic importance. Among the sub- genera, species *persica* (Peach and nectarine) ranked third as most agronomically important plant in temperate regions after apple and pear. A high germination percentage coupled with a desirable growth habit is the basic requirement of a good seedling rootstock. Peach seeds/stones remain dormant for a long period after harvest and fail to germinate until subjected to low temperature conditions. Presence of hard seed coat, long duration of stratification, poor germination of seeds, delay in emergence and abnormal growth of the seedlings from non and after ripened seeds are the factors which pose problems with respect to propagation of nursery stocks. Dormancy is a condition in which seeds do not germinate even when the environmental conditions (water, temperature and aeration) are permissive for germination (Nikolaeva, 1977; Bewley and Black, 1994; Hartmann *et al.*, 1997). Dormancy ensures a seed to survive during winter freezes. Peach seeds have two independent dormancies, a physical (external) dormancy and embryo (internal) dormancy (García, Martínez and Dicenta, 2004). Scarification is a method used to break physical dormancy and it includes removing the seed coat or wounding the seed coat. It is a method used to break embryo dormancy. Stratification exposes seeds to treatment cold moist or warm moist environments, to allow breakage of embryo dormancy. Stratification plays an important role as a stimulator that helps to break dormancy (Bewley, Black, 1994; Agrawal & Dadlani 1995; Hartmann *et al*, 1997). In order to accelerate this method, it can be combined with some treatments such as chemical applications or mechanical seed coat removal (Mehanna *et al*, 1985; Martinez-Gomez & Dicenta, 2001). Recently, PAU has released a new rootstock 'Flordaguard' for peach. This rootstock is resistant to root knot nematodes and is also compatible with all the peach cultivars (Singh, 2010). But, there is a big problem of seed germination in this rootstock. The present research work was planned to investigate the best planting time and treatment for good seed germination under agro ecological conditions of Ludhiana, Punjab.

MATERIALS AND METHODS

The experimental material used for the study consisted of eight treatments viz.stratification (T_1), scarification (T_2), GA_3 @ 100 ppm (T_3), GA_3 @ 200 ppm (T_4),Thiourea @ 0.5% (T_5), Thiourea @ 1.0% (T_6), Kinetin @ 100 mg (T_7) and Kinetin @ 200 mg (T_8) under three different dates (15th December 2010, 25th December2010 and 5th January2011) in the experimental farm area of Fruit science department Punjab Agricultural University

Ludhiana during 2010-2011. Thedata thus recorded were analyzed in Randomized Block Design as per method suggested by Gomez and Gomez (1984) with 4 replication.The treatments were replicated thrice and 50 seeds were sown under each replication.

Fully matured fruits of rootstock 'Flordaguard' were harvested from tree during 2nd week of July and the stones were extracted from the flesh, washed thoroughly with tap water and kept at room temperature. After removing all the extraneous materials seeds were dipped in water and then only the healthy seeds which settled down were kept for stratification in small lots in gunny bags in cold storage at 0 + 3ºC and 85- 90% RH for a period of 90 days, after stratification seeds were soaked in various Growth Regulators and distilled water for 24 hours at room temperature during the month of December and directly sown in the nursery beds. The data were recorded from randomly selected 15 seedlings under each replication and values were averaged.To calculate duration of seed germination start of seed germination when 10% of seedlings emerged and end of seed germination when germination was completed and no more sprouting took place were recorded and total number of days between start and end of germination were counted. To calculate per cent germination number of emerged seedlings were counted when the germination was completed by the given formula.

$$\frac{\text{Number of seedlings germinated}}{\text{Total number of seeds sown}} \times 100$$

Observations on height (cm) and girth (cm) were taken at the end of season when the growth was seized i.e. month of December. The data on seedling girth were recorded in the month of December. The girth was recorded at a height of 10 cm from the ground level with the help of digital vernier calliper and expressed as average girth per seedling in cm.Mortality of the seedlings was recorded during December by counting the number of seedlings died after the emergence. The per cent mortality was calculated as:

$$\frac{\text{Number of seedlings died}}{\text{Total number of seedlings emerged}} \times 100$$

Observations on number of seedlings ready for grafting were recorded in the month of December when all the seedlings were uprooted. The number of seedlings ready for grafting was counted and the per cent seedlings were calculated as:

$$\frac{\text{Number of seedlings fit for grafting}}{\text{Total number of seedlings emerged}} \times 100$$

RESULTS AND DISCUSSION

Duration of seed germination and percent seed germination

The data on the effect of different treatments on the duration of seed germination in peach rootstock 'Flordaguard' is presented in Table 1. The data reveals that the duration of seed germination irrespective of the treatments was maximum when the seeds were sown on 15th December (22.57) and minimum (19.45) when they were sown on 25th December. Among the treatments, duration of seed germination was minimum (16.33)in T_2 and maximum (30.33) in kinetin treatments on all the sowing dates. Minimum duration of 14 days was observed in T_2, sown on 25th December and 5th January. Maximum duration of 25 days was observed in all the treatments (except T_2 and T_5) sown on 15th December. This may be due to the fact that seeds under this treatment were sown after mechanically rupturing of the seed which favoured early sprouting. In all other treatments, the presence of hard seed coat provided resistance to the embryo which delayed the germination. Du Toit *et al.* (1979) observed that endocarp affected peach seed germination by delaying water uptake. Mehanna and Martin (1985) also concluded that the seed coat provides mechanical resistance for germination in peach. These studies showed that if the seed's endocarp was removed it had an overall higher percentage of germination than those seeds whose endocarp was left intact. This shows that stratification alone and in combination of thiourea, GA and kinetin is not effective for seed germination in peach rootstock 'Flordaguard'. The data on the effect of different treatments on per cent seed germination in peach rootstock 'Flordaguard' is also presented in Table 1. The data shows that mean seed germination was found to be maximum (22.57%) when the seeds were sown on 15th December and it was significantly higher than the seeds sown on 25th December (20.20%). The per cent seed germination was found to be minimum (14.80%) on the 3rd sowing date (5th January). Among the treatments, maximum mean seed germination (57.26%) was recorded in T_2, where the seeds were sown after rupturing the seed coat and it was significantly higher than all other treatments. The mean seed germination in T_1 (control), T_3 and T_4 (GA_3 treatments) were found to be statistically at par. Minimum mean seed germination was recorded in Thiourea and Kinetin treatments. The data further shows that maximum seed germination (67.2%) was recorded in T_2, sown on 25th December and it was significantly higher than all other treatments. It was followed by the same treatment sown on 5th January (54.0%) and 15th December (50.6%), respectively. The seed germination under control (T_1) and GA_3 treatments (T_3 and T_4) sown on 15th December was found to be better than sown on other dates. In Thiourea and Kinetin treatments, seed germination was found to be poor at all the sowing dates. In general, seed germination in all the treatments was less when sown on 15th December as compared to other sowing dates. Higher seed germination in T_2 treatment was due to the absence of barrier provided by the seed coat for germination. Zigas and Coomb (1977) reported that removal of seed coat of peach seeds eliminates the physical dormancy and stratification eliminates internal dormancy. Eliminating physical dormancy by removing the endocarp provides better chances for germination of peach seeds. Gianfagna and Rachmial (1986) found that the effects of Gibberellins on the seeds were found to be negligible if the endocarp was left intact. During the present studies also, the growth regulators did not improve seed germination in peach rootstock 'Flordaguard' although these treatments have been found to break dormancy and improve seed germination in stone fruits (Dweikat and Lyrene, 1988; Karam and Al-Salem, 2001and Mehanna *et al.,* 1985).

Height and girth of the seedlings

The data with respect to height and girth given in Table 2

Table 1: Effect of different treatments on start of seed germination in peach rootstock " Flordaguard"

TREATMENTS	Duration of the seed germination (days) Dates				Percent seed germination Dates			
	15 Dec 2010	25 Dec 2010	5 Jan 2011	Mean	15 Dec 2010	25 Dec 2010	5 Jan 2011	Mean
T1—Stratification (control)	35	21	21	25.66	29.2	13.6	13.2	18.66
T2—Scarification	21	14	14	16.33	50.6	67.2	54.0	57.26
T3—GA_3 100 ppm	35	28	28	30.33	22.0	18.0	11.6	17.20
T4—GA_3 200 ppm	35	28	28	30.33	24.4	21.2	12.0	19.20
T5—Thiourea 0.5 %	28	21	28	25.66	12.8	6.0	5.6	8.13
T6—Thiourea 1.0 %	35	21	21	25.66	16.8	8.4	6.8	10.66
T7—Kinetin 100mg	35	28	28	30.33	12.0	10.4	7.2	9.86
T8—Kinetin 200mg	35	28	28	30.33	12.8	10.8	8.0	10.53
MEAN	32.37	23.62	24.50		22.57	19.45	14.8	

CD (p=0.05) D=0.73 T= 1.19 D X T=2.07

Table 2: Effect of different treatments on the height (cm) and girth (cm) of the seedlings of the peach rootstock "Flordaguard"

TREATMENTS	Height (cm) of the seedlings Dates				Girth (cm) of seedlings Dates			
	15 Dec 2010	25 Dec 2010	5 Jan 2011	Mean	15 Dec 2010	25 Dec 2010	5 Jan 2011	Mean
T1—Stratification (control)	91.4	95.2	71.8	86.13	0.47	0.48	0.47	0.47
T2—Scarification	130.2	135.7	125.8	130.56	0.57	0.57	0.57	0.57
T3—GA_3 100 ppm	76.5	79.4	71.2	75.70	0.40	0.41	0.40	0.40
T4—GA_3 200 ppm	74.2	80.6	73.3	76.03	0.40	0.41	0.41	0.41
T5—Thiourea 0.5 %	70.4	73.2	69.0	70.86	0.37	0.38	0.38	0.37
T6—Thiourea 1.0 %	70.6	74.8	68.3	71.23	0.38	0.38	0.39	0.38
T7—Kinetin 100mg	66.6	70.0	64.8	67.13	0.35	0.36	0.35	0.35
T8—Kinetin 200mg	67.0	70.8	65.3	67.70	0.36	0.36	0.36	0.36
MEAN	80.86	84.96	76.18		0.41	0.42	0.41	

CD (P=0.05) D=1.92 T= 3.14 D X T= 5.44 CD (P=0.05) D= NS T= 0.01 D X T= NS

Table 3: Effect of different treatments on mortality and number of seedlings ready for grafting of the peach rootstock "Flordaguard"

TREATMENTS	Mortality of the seedlings Dates				Number of the seedlings ready for grafting Dates			
	15 Dec 2010	25 Dec 2010	5 Jan 2011	Mean	15 Dec 2010	25 Dec 2010	5 Jan 2011	Mean
T1—Stratification (control)	4.2	4.0	3.5	3.9	22.0	10.2	9.6	13.93
T2—Scarification	2.2	1.5	2.0	1.9	41.3	55.4	42.9	46.53
T3—GA_3 100 ppm	4.0	3.8	4.5	4.1	15.7	12.8	8.0	12.16
T4—GA_3 200 ppm	3.1	3.5	3.0	3.2	18.2	15.6	8.8	14.20
T5—Thiourea 0.5 %	4.8	5.2	4.5	4.8	8.2	3.7	3.5	5.13
T6—Thiourea 1.0 %	2.8	3.0	3.2	3.0	11.5	5.3	4.5	7.10
T7—Kinetin 100mg	4.5	3.8	3.9	4.06	7.9	6.8	4.6	6.43
T8—Kinetin 200mg	3.0	2.9	2.6	3.83	8.7	7.3	5.3	7.10
MEAN	3.57	3.46	3.40		16.68	14.63	10.9	

CD (p=0.05) D= NS T= 0.59 D X T= NS CD (p=0.05) D= NS T= 0.37 D X T= 0.65

shows that the mean seedling height during December was found to be maximum (84.96 cm) when the seeds were sown on 2nd date (25th December) and it was significantly higher than those sown on 15th December (80.86 cm) and 5th January (76.18 cm). Among the treatments, T_2 recorded maximum mean seedling height (130.56 cm) and it was significantly higher than all other treatments. The minimum seedling height was recorded in Kinetin treatments (T_7 and T_8). Maximum seedling height during December was recorded in T_2 (135.7 cm) sown on 25th December followed by this treatment sown on 15th December and 5th January. The seedling height under GA_3, Thiourea and Kinetin treatments was found to be lower during the present studies. In contrast to these findings, Abo-Hassan (1986) reported that stratification followed by GA_3 treatment improved seed germination and increased plant height in apricot. Similar trend was observed in case of girth where the mean seedling girth during December was found to be maximum (0.42 cm) when the seeds were sown on 2nd date (25th December) and it was statistically at par with those sown on 15th December and 5th January. Among the treatments, T_2 recorded maximum mean seedling girth (0.57 cm) and it was significantly higher than all other treatments. The minimum seedling girth was recorded in Kinetin treatments (T_7 and T_8). Maximum seedling girth during December was recorded in T_2 (0.57 cm) sown on 25th December followed by this treatment sown on 15th December and 5th January. The next best treatment was found to be T_1 (control), on all the sowing dates. The data on seedling girth reveals that sowing dates had no significant effect but the treatment had a significant effect on the girth of 'Flordaguard' seedlings during the present studies. The maximum seedling girth was recorded in T_2, where the seeds were sown after rupturing the seed coat and it was significantly higher than all other treatments. It was followed by T_1 (control) and T_4 (seeds sown after treating with GA_3 @ 200 ppm). Higher seedling girth under T_2 was due to the reason that removal of endocarp facilitates early germination which resulted in better girth of 'Flordaguard' seedling under the present studies. Abo-Hassan *et al.* (1979) also found better seedling growth in apricot when the seeds were sown after scarification.

Mortality rate (%) of seedlings and seedlings ready for grafting

The data on the effect of different treatment on the mortality rate (%) of the 'Flordaguard' seedlings recorded during the month of December presented in Table 3. The data shows that maximum mean mortality of the seedlings (3.57%) was recorded in the treatment sown on 15th December and it was significantly higher than mortality rate of the seedlings observed 1st (25th December) and 2nd (5th January) sowing dates. Among the treatments, minimum mean mortality (1.9%) was recorded in T_2, where seeds were sown after rupturing the seed coat and it was significantly lower than all other treatments. The mean mortality rate of the seedlings was found to be maximum in Thiourea and Kinetin treatment and it was significantly higher than all other treatment. The data further shows that on the 1st sowing date (15th December), maximum mortality (4.8%) was recorded in T_5 and minimum (2.2%) in T_2. On the 2nd sowing date (25th December), minimum mortality rate was again recorded in T_2 followed by T_1 and maximum in T_5. On the 3rd date (5th January), similar trend was observed where the mortality rate of the seedlings continued to remain highest in Thiourea and Kinetin treatment. The examination of the data reveals that mortality rate of the seedlings were significantly less in T_2 as compared to other treatments. This was due to the reason that early germination results into longest radicle which helped in early establishment of new seedling to produce maximum food material with the help of photosynthesis that resulted into the maximum survival of seedlings. The data on the effect of different treatments on the number of seedlings ready for grafting in the last week of December is also presented in Table 3. The data shows that sowing dates had no significant effect on the seedlings reaching grafting stage during the present studies. Among the treatments, highest seedlings (46.53%) ready for grafting were found in T_2, where the seeds were sown after rupturing the seed coat and it was significantly higher than all other treatments. The next best treatment was found to be T_1 (control) where 41.3% seedlings were found ready for grafting in December. The least number of seedlings ready for grafting were recorded in Thiourea and Kinetin treatment and these were found to be statistically at par with each other. On the 1st sowing date (15th December), maximum seedlings (41.3%) ready for grafting were recorded in T_2 and it was followed by T_1 (Control) and GA treatment (T_4 and T_3) where 22.0%, 18.2% and 15.7% seedlings were found fit for grafting. In other treatments, approximately 11% of the seedlings were found ready for grafting. On the 2nd (25th December) and 3rd (5th January) sowing dates, again maximum seedlings ready for grafting were recorded in T_2 (55.4% and 42.9%, respectively) and it was significantly higher than all other treatments. In all other treatments the number of seedlings fit for grafting was found to be significantly less than T_2 and T_1 during the present studies. Higher number of seedlings fit for grafting in T_2 was probably due to more girth and height of the seedlings recorded under this treatment in the present studies.

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