

**RESPONSE OF *DODONAEA VISCOSA* (L.) JACQ.
TRANSPLANTS TO PACLOBUTRAZOL SPRAY AND
IRRIGATION PERIODS**

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ABSTRACT : *A study was carried out at the Experimental Farm of Hort. Res. Inst., Giza, Egypt during the two successive seasons of 2006 and 2007 to detect the effects of foliar spray with paclobutrazol (PP-333) at the rates of 0, 100, 200 and 300 ppm for three times with three weeks interval, irrigation once every 3, 6 or 9 days with 250 ml of fresh water black polyethylene bag (30-cm.-diameter) and their interactions on growth behaviour and chemical composition of 6-months-old Dodonaea viscosa (L.) Jacq. transplants.*

The obtained results indicated that plant height (cm.), branch and leaf No./plant, leaf area (cm²), as well as fresh and dry weights of aerial parts and roots (g) were significantly decreased as a result of spraying PP-333 at various levels in most cases of both seasons. On the other hand, irrigation for 6 days treatment gave, in general the highest means in all previous parameters with significant differences when compared to irrigation every either 3 or 9 days treatments in most cases of the two seasons. The dwarfing result, however was achieved by plants sprayed with the medium concentration of PP-333 (200 ppm) and watered once every 6 days, as this combined treatment gave the most suitable plant size, proper for establishment as a small-sized plant hedge which needs the least pruning.

Water use efficiency (W.U.E) was greatly increased with decreasing water supply, but was declined with raising the concentration of PP-333. The content of chlorophyll a, b, carotenoids and indoles in the leaves was gradually decreased in response to elevation of PP-333 concentration, whereas phenols content was progressively increased. However, the effect of irrigation periods on the previous constituents was fluctuated in both seasons.

So, it is recommended to spray the 6-months-old Dodonaea viscosa (L.) Jacq. transplants grown in 30-cm- diameter black polyethylene bag with PP-333 at 200 ppm for 3 times with 3 weeks interval and should be irrigated once every 6 days with 250 ml of fresh water to get a stunted specimen suited for hedging with the least number of pruning times.

Key words: *Dodonaea viscosa (L.) Jacq. , Paclobutrazol, stunting, irrigation periods and chemical composition.*

INTRODUCTION

Dodonaea viscosa (L.) Jacq. (Hop bush), Fam. Sapindaceae is one of the most widespread tropical and subtropical shrubs cultivated in various types of soils for amenity, compact and evergreen hedges, as well as a solitary specimen on lawns and turf. It reaches up to 4.5 m height, usually has sticky shoots and undivided obovate-oblong to lanceolate leaves, which reach about 10-12 cm long and 2.5 cm wide.

Flowers are greenish and usually appearing in terminal racemes (Huxley *et al.*, 1992).

Nowadays, the most widely used plant growth regulators for ornamentals are the growth retarding chemicals, which are utilized commercially to produce compact and miniature potted plants. Hence, many efforts were made to examine the effect of several retardants on growth control and flowering habit for bonsai production. In this respect, Wei and Han (1997) reported that applying paclobutrazol at 25, 50, 75 and 100 ppm significantly reduced plant height and shoot number of chrysanthemum. Proietti *et al.* (1998) indicated that PP-333 application at 2 g/tree inhibited shoot and root growth of 1-year-old chestnut tree. On potted sunflower, Dasoju *et al.* (1998) postulated that leaves of plants treated with PP-333 at 16 or 32 mg/pot were smaller and greener than those of untreated ones. Singh *et al.*, (1999) mentioned that spraying of paclobutrazol at 10-30 ppm greatly reduced height, shoot and leaf number of sweet pepper, while number of flowers/plant was increased. Similar observations were also gained by Starman and Williams (2000) on *Scaevola aemula*, Sarhan *et al.*, (2001) on *Althaea rosea*, Chen *et al.*, (2002) on *Gynura aurantiaca*, Kozak (2002) on *Gloriosa rothschildiana* and Auda *et al.*, (2002) who stated that plant height, branch and leaf No./plant, leaf area and aerial parts and roots fresh and dry weights of *Barleria cristata* were significantly declined in response to PP-333 spraying at 150 ppm. Likely, Barrett *et al.*, (2003) revealed that uniconazole application as a spray to the surface of media prior to planting at the level of 200 ml/m² decreased plant height of *Petunia hybrida*, *Coleus scutellarioides*, *Impatiens walleriana* and *Chatharanthus roseus*. In 2004, Pasian and Bennett declared that soaking ornamental kale (*Brassica oleracea* var. *viridis*) seeds in paclobutrazol solution (500 or 1000 mg/L.) for 180 minutes significantly reduced plug height, which was thicker and straighter than those produced from untreated seeds. Recently, Schroeter and Jerzy (2006) found that the strongest and longest-lasting inhibitory effect on the growth of *Impatiens walleriana* bedding plants was due to daminozide and chlormequat as foliar application at a concentration of 690 mg/L.

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Most of chemical constituents of plants were invariably affected by the treatment with growth retardants, thus, Auda *et al.*, (2002) mentioned that chlorophyll a and b content in the leaves of *Barleria cristata* was progressively decreased with increasing PP-333 concentration, but carotenoids content was increased. Moreover, Shahin *et al.*, (2006 a) stated that total indoles content in the leaves of *Rudbeckia hirta* plant was cumulatively decreased with increasing ccc concentration after the second spray, while the total phenols content was increased. After the third spray, however both indoles and phenols were increased. Pigments content, as well as total carbohydrates and the percentages of N and K in the leaves and roots were linearly decreased with raising ccc level, while P% showed a slight increase.

Concerning the effect of water deficit on growth and chemical composition of plants, Abdel-Gayed (2001) stated that growth of *Agave sisalana* plants was reduced when water supply was limited. Chlorophylls content was decreased with high drought, while N and proline contents were increased. Fox and montague (2004) pointed out that medium (irrigation every other day) and high (irrigation every fourth day) drought increased rooting % and the mean root length of *Photinia fraseri* cv. Red Robin cuttings. In addition, Shahin *et al.*, (2006 b) indicated that vegetative and root growth of sisal plant were greatly decreased with reducing irrigation water amount from 75% of F.C. to 30 or 45%. Leaves content of chlorophyll a, b and carotenoids, the percentages of total carbohydrates, N, P and K in the leaves and roots, as well as the content of proline in the leaves were also decreased.

Such study, however aims to explore the effect of paclobutrazol spray, irrigation intervals and their interaction on growth behaviour and chemical composition of *Dodonaea viscosa* (L.) Jacq. transplants grown under climatic conditions of Giza Governorate.

MATERIALS AND METHODS

A trial was performed at the Experimental Farm of Hort. Res. Inst., Giza, Egypt during 2006 and 2007 seasons to find out the response of *Dodonaea viscosa* (L.) Jacq. transplants to paclobutrazol treatments, irrigation periods and their interactions, and to determine the most suitable concentration of PP-333 necessary for controlling growth, and consequently reducing the number of pruning times.

Six-months-old transplants of *Dodonaea viscosa* (L.) Jacq. (produced from seeds germinated under nursery conditions) with initial height of 20 ± 2 cm and carry about 40-50 leaves were transplanted on March, 15th for both seasons into 30-cm-diameter black polyethylene bag (one transplant/bag)

filled with 3 kg of a mixture of equal parts of sand and loam, v/v in the open field under the full sun. The physical and chemical analyses of the used mixture are shown in Table (a).

Table (a): Physical and chemical analyses of the used texture in the two seasons of 2006 and 2007.

| Analysis | SP (%) | E.C. (mmhos/cm) | pH | Particle size distribution (%) | | | | Texture | Cations (meq/L.) | | | | Anions (meq/L.) | | |
|------------------------|--------|-----------------|------|--------------------------------|-----------|-------|------|------------|------------------|------------------|------------------|----------------|-------------------------------|-----------------|------------------------------|
| | | | | Coarse sand | Fine sand | Clay | Silt | | Ca ⁺⁺ | Mg ⁺⁺ | Na ⁺⁺ | K ⁺ | HCO ₃ ⁻ | Cl ⁻ | SO ₄ ⁻ |
| 1 st season | 25.86 | 8.12 | 8.12 | 74.47 | 6.38 | 12.45 | 6.70 | Sandy loam | 24.12 | 10.00 | 36.55 | 1.56 | 3.60 | 25.00 | 44.68 |
| 2 nd season | 26.03 | 8.05 | 8.05 | 73.85 | 7.00 | 12.25 | 6.90 | Sandy loam | 25.72 | 9.38 | 37.21 | 1.42 | 3.48 | 24.33 | 46.91 |

The plants were regularly irrigated (once every three days) with 250 ml of fresh water/bag. After one month later (on 15th of April), the plants were subjected to the following treatments:

a. Paclobutrazol treatments:

Paclobutrazol (PP-333 or cultar) at the levels of 0, 100, 200 and 300 ppm was sprayed at 3 weeks interval for 3 times on the foliage till run off. Control plants, however were sprayed with a tap water.

b. Irrigation period treatments:

As the plants were irrigated once every 3, 6 or 9 days with 250 ml of fresh water/bag starting from April, 15th until the end of the experiment on October, 30th. Thus, the plants were irrigated 65, 32 and 22 times throughout the course of the study for the 3 irrigation period treatments mentioned above, respectively.

c. Paclobutrazol and irrigation period interaction treatments:

All PP-333 levels were combined with each period of irrigation to form twelve interaction treatments.

Factorial in a complete randomized design was used in the two seasons, with three replicates as each replicate contained six plants (Mead *et al.*, 1993).

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At the end of each season, the following data were recorded: plant height (cm), number of branches and leaves/ plant, leaf area (cm²) and aerial parts and roots fresh and dry weights (g). Total amount of water/plant/season was computed by multiplying the number of irrigation times throughout the season, which were 65, 32 and 22 times for irrigation every 3, 6 and 9 days treatments, respectively by the amount of water used in each irrigation, which was 250 ml/bag. Water use efficiency (ml/g D.M.) was then calculated by dividing the total amount of water/plant/ season by the total amount of dry matter (g)/plant/season to determine the quantity of water necessary for producing 1 g of dry matter by *Dodonaea* plant under various PP-333 levels used in the present study. In fresh leaf samples taken from the middle part of the plant, pigments content (chlorophyll a, b and carotenoids, mg/g F.W.) was determined according to Moran (1982), total indoles (A.O.A.C., 1990) and total phenols (William *et al.*, 1965) as mg/g F.W. were also measured.

Data were then, tabulated and subjected to analysis of variance using SAS program (1994) and Duncan's Multiple Range Test (1955) was used to elucidating the significancy level among the means of various treatments.

RESULTS AND DISCUSSION

I. Effect of PP-333 sprays, irrigation periods and their interaction on vegetative and root growth and water use efficiency:

According to data presented in Table (1) and (2), it is evident that as the paclobutrazol rates applied to *Dodonaea viscosa* transplants were increased, the final plant height (cm), branch and leaf No./plant, leaf area (cm²) and aerial parts and roots fresh and dry weights (g) were declined with various levels of significance in the two seasons. The opposite was the right concerning irrigation period treatments, as irrigation every 6 days treatment gave, in general the highest means in all parameters mentioned above with significant differences when compared to irrigation every 3 or 9 days treatments in most cases of both seasons. However, the best dwarfing result was obtained from plants sprayed with the medium concentration of PP-333 (200 ppm) and watered once every 6 days, as this combined treatment gave the most suitable plant size going with good growth and health proper for establishment of a small-sized plant hedge needs little pruning (Photo, 1). On the other hand, the low PP-333 level (100 ppm) induced a slight reduce in size of plant, whereas the highest one (300 ppm) resulted in excessive growth reduction (more than 50%), accompanied with some morphological disorders (as crinkled leaves, smaller leaves and induction of epinasty).

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Photo (1): Effect of PP-333 at the rate of 200 ppm on growth of *D. viscosa* plant (left) compared with control (right).

Such results might be interpreted according to the direct role of PP-333 in retarding stem elongation by reducing cell division and extension in the subapical meristematic zone of the stem (Wei and Han, 1997) or by inhibition of cytokinins and gibberellins biosynthesis (Kozak, 2002). Similarly, were the

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results attained by Proietti *et al.*, (1998) on chestnut tree, Sarhan *et al.*, (2001) on *Althaea rosea*, Barrett *et al.*, (2003) on *Petunia hybrida* and Schroeter and Jerzy (2006) on *Impatiens walleriana*.

It is clear from data in Table (3) that water use efficiency (W.U.E.) in the two seasons was greatly increased with decreasing water supply, specially for irrigation every 6 days treatment, which declined the amount of water necessary for producing 1 g of dry matter to 330.01 and 262.82 ml against 432.22 and 396.77 ml for irrigation every 9 days and to 991.13 and 884.03 ml for irrigation every 3 days in the first and second seasons, respectively.

Table (3) Water use efficiency by *Dodonaea viscosa* (L.) Jacq. transplant under the different levels of PP-333, irrigation periods and their interaction during 2006 and 2007 seasons.

| Total amount of water (ml/ plant/season) | PP-333 treatments (ppm) | Total D.M. (g)/ plant/season | | W.U.E. (ml/g D.M.) | |
|--|-------------------------|------------------------------|-------|--------------------|---------|
| | | 2006 | 2007 | 2006 | 2007 |
| 16250 (for irrigation every 3 days) | 0.00 | 42.79 | 58.20 | 379.76 | 279.21 |
| | 100.00 | 33.83 | 44.07 | 480.34 | 368.73 |
| | 200.00 | 11.86 | 15.01 | 1370.15 | 1082.61 |
| | 300.00 | 9.37 | 9.00 | 1734.26 | 1805.56 |
| Mean | | 24.46 | 31.57 | 991.13 | 884.03 |
| 8000 (for irrigation every 6 days) | 0.00 | 66.07 | 76.29 | 121.08 | 104.86 |
| | 100.00 | 39.51 | 49.38 | 202.48 | 162.01 |
| | 200.00 | 22.41 | 27.08 | 356.98 | 295.42 |
| | 300.00 | 12.51 | 16.36 | 639.49 | 489.00 |
| Mean | | 35.13 | 42.28 | 330.01 | 262.82 |
| 5500 (for irrigation every 9 days) | 0.00 | 41.86 | 48.55 | 131.39 | 113.29 |
| | 100.00 | 24.60 | 34.78 | 223.58 | 158.14 |
| | 200.00 | 9.46 | 11.78 | 581.40 | 466.89 |
| | 300.00 | 6.94 | 6.48 | 792.51 | 848.77 |
| Mean | | 20.72 | 25.40 | 432.22 | 396.77 |
| Paclobutrazol treatment mean | 0.00 | 50.24 | 61.01 | 210.74 | 165.79 |
| | 100.00 | 32.65 | 42.74 | 302.13 | 229.63 |
| | 200.00 | 14.58 | 17.96 | 769.51 | 614.97 |
| | 300.00 | 9.61 | 10.61 | 1055.42 | 1047.78 |

D.M.: Dry matter.

W.U.E.: Water use efficiency

Such result may indicate that the more supply of water leads generally to more loss of soil moisture through drainage, greater foliage transpiration and a high evaporation from the relatively wet soil rather than dry one. On the other hand, such parameter was linearly decreased with elevating PP-333 concentration under various irrigation periods applied in the study. However, the best W.U.E. was gained from irrigation every 6 days under 00.00 ppm of PP-333 in both seasons.

Such findings, however are in harmony with those of both Abdel Gayed (2001) and Shahin *et al.*, (2006 b) on *Agave sisalana*.

II. Effect of PP-333 spray, irrigation periods and their interaction on chemical composition:

It was obvious from data registered in Table (4) that chlorophyll a, b, carotenoids and indoles contents in the leaves were gradually decreased in response to increasing PP-333 concentration with significant differences in most cases of both seasons, except for PP-333 treatment at the rate of 100 ppm, which significantly raised the leaves content of carotenoids in the two seasons. The opposite was the right concerning phenols content, as it was progressively increased with increasing PP-333 concentration in the two seasons.

Such gains may exhibit the role of PP-333 in retarding the biosynthesis of some growth promoters (indoles, cytokinins, ... etc.) against elevation of the content of some inhibitors (phenols) in the tissues of treated plants (Kozak, 2002). On the same line, were those results mentioned by Auda *et al.*, (2002) on *Barleria cristata*, Pasion and Bennett (2004) on ornamental kale (*Brassica oleracea* var. *viridis*) and Shahin *et al.*, (2006 a) on *Rudbeckia hirta*.

On the other hand, the effect of irrigation periods on the previous constituents was fluctuated in both seasons, but the highest records were gained mostly from irrigation once every 3 or 6 days comparing with irrigation every 9 days. This is reasonable, as it supplies *Dodonaea* plants with the water necessary for good and healthy growth. However, these results coincide with those of Abdel-Gayed (2001) on sisal, Fox and Montague (2004) on *Photinia fraseri* and Shahin *et al.*, (2006 b) on *Agave sisalana*.

According to the aforestated results, it could be concluded that, 6-months-old transplants of *Dodonaea viscosa* (L.) Jacq. grown in 30-cm-diameter black polyethylene bag should be sprayed with PP-333 at 200 ppm for 3 times with 3 weeks interval coupled with irrigation once every 6 days with 250 ml of fresh water to get a stunted specimen suited for hedging with the least number of pruning times.

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استجابة شتلات الدودونيا للرش بالباكلوبيوترازول و فترات الري

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الملخص العربي

أجريت هذه الدراسة بالمزرعة التجريبية بمعهد بحوث البساتين، الجيزة، مصر خلال الموسمين المتتاليين: ٢٠٠٦، ٢٠٠٧ لمعرفة تأثير الرش بالباكلوبيوترازول بتركيزات: صفر، ١٠٠، ٢٠٠ و ٣٠٠ جزء في المليون، ثلاث مرات و فواصل ثلاثة أسابيع بين كل رشتين، و الري مرة كل ٣، ٦، ٩ أيام بـ ٢٥٠ مل مياه عذبة/كيس بلاستيك (قطره ٣٠ سم)، و المعاملة المشتركة بينهما على النمو و التركيب الكيميائي لشتلات الدودونيا (*Dodonaea viscosa* (L.) Jacq.) عمر ستة أشهر.

و لقد أوضحت النتائج المتحصل عليها أن ارتفاع النبات (سم)، عدد الأفرع و الأوراق لكل نبات، مساحة الورقة (سم^٢) و كذلك الأوزان الطازجة و الجافة للنموات الخضرية و الجذور قد انخفضت معنوياً نتيجة للرش بالتركيزات المختلفة من الباكلوبيوترازول في معظم الحالات لكلا الموسمين. وعلى الجانب الآخر، فقد أعطت معاملة الرش مرة كل ستة أيام أعلى المتوسطات في جميع القياسات المذكورة سابقاً و بفروق معنوية عند مقارنتها بالري كل ثلاث أو تسعة أيام في معظم الحالات بكلا الموسمين.

إلا أن أفضل نتائج التقزيم أمكن الحصول عليها من الرش بالتركيز المتوسط من الباكلوبيوترازول (٢٠٠ جزء/المليون) مع الري مرة كل ستة أيام، حيث أعطت هذه المعاملة المشتركة الحجم الملائم لإنشاء سياج نباتي صغير الحجم يحتاج فقط إلى قليل من التقليم.

وقد أوضحت النتائج أيضاً أن كفاءة استخدام المياه (W.U.E.) قد زادت بدرجة كبيرة بخفض الإمداد المائي (الري على فترات متباعدة، خاصة كل ست أيام)، لكنها انخفضت تدريجياً بزيادة تركيز الباكلوبيوترازول.

كذلك انخفض تدريجيا محتوى الأوراق من كلوروفيللي أ، ب و الكاروتينويدات و الاندولات بزيادة تركيز الباكلوبيوترازول، بينما زاد محتوى الفينولات. أما تأثير معاملات فترات الري على المكونات السابقة فقد كان متقلباً في كلا الموسمين.

و عليه، يمكن التوصية برش شتلات الدودونيا عمر ستة أشهر و المنزرعة في أكياس بلاستيك سوداء قطرها ٣٠ سم بالباكلوبيوترازول تركيز ٢٠٠ جزء/المليون ثلاث مرات و بفاصل ثلاثة أسابيع بين كل رشتين مع ريها مرة كل ستة أيام (٢٥٠ مل مياه عذبة/ كيس بلاستيك) للحصول على نماذج مقزمة ملائمة لإنشاء الأسيجة النباتية محدودة النمو و التي لا تحتاج لكثير من التقليم.

Table (1) Effect of PP-333, irrigation periods and their interaction on some vegetative growth parameters of *Dodonaea viscosa* (L.) Jaq. transplant during 2006 and 2007 seasons.

| Irrigation periods every PP-333 treatments (ppm) | Plant height (cm) | | | | Branch No./plant | | | | Leaf No./plant | | | | Leaf area (cm ²) | | | |
|--|---------------------|---------------------|---------------------|--------------------|---------------------|---------------------|---------------------|--------------------|----------------------|----------------------|----------------------|---------------------|------------------------------|---------------------|---------------------|--------------------|
| | 3 days | 6 days | 9 days | Mean | 3 days | 6 days | 9 days | Mean | 3 days | 6 days | 9 days | Mean | 3 days | 6 days | 9 days | Mean |
| First season: 2006 | | | | | | | | | | | | | | | | |
| 0.0 | 58.45 ^a | 53.16 ^b | 47.33 ^c | 52.98 ^a | 22.33 ^a | 24.17 ^a | 19.28 ^b | 21.93 ^a | 987.96 ^a | 915.53 ^b | 681.33 ^c | 861.61 ^a | 17.00 ^a | 15.76 ^{ba} | 14.67 ^{cb} | 15.81 ^a |
| 100 | 43.56 ^{de} | 40.67 ^e | 38.56 ^{ef} | 40.93 ^b | 18.46 ^{bc} | 18.00 ^{cb} | 15.50 ^c | 17.32 ^b | 670.86 ^c | 583.41 ^d | 470.56 ^e | 574.94 ^b | 14.86 ^{bc} | 15.33 ^b | 13.33 ^c | 14.51 ^b |
| 200 | 35.33 ^f | 33.39 ^g | 31.23 ^{hg} | 33.48 ^c | 13.76 ^{cd} | 18.00 ^{cb} | 13.00 ^{cd} | 14.92 ^c | 385.76 ^f | 596.65 ^d | 360.00 ^{fg} | 447.47 ^c | 12.53 ^{dc} | 14.76 ^{cb} | 10.50 ^e | 12.60 ^c |
| 300 | 27.81 ^h | 25.67 ^{hi} | 25.00 ⁱ | 26.16 ^d | 12.38 ^d | 15.78 ^c | 10.26 ^e | 12.81 ^d | 247.00 ^h | 340.26 ^g | 252.48 ^{hg} | 279.91 ^d | 11.42 ^d | 10.85 ^{ed} | 9.37 ^f | 10.55 ^d |
| Mean | 41.29 ^a | 38.35 ^b | 35.53 ^c | | 16.73 ^b | 18.99 ^a | 14.51 ^c | | 572.90 ^b | 608.96 ^a | 441.09 ^c | | 13.95 ^a | 14.18 ^a | 11.97 ^b | |
| Second season: 2007 | | | | | | | | | | | | | | | | |
| 0.0 | 67.33 ^a | 61.50 ^b | 52.00 ^c | 60.28 ^a | 23.45 ^b | 27.15 ^a | 21.00 ^{ba} | 23.87 ^a | 758.10 ^b | 945.46 ^a | 594.95 ^c | 766.17 ^a | 16.56 ^a | 15.24 ^{ba} | 15.00 ^b | 15.60 ^a |
| 100 | 40.82 ^d | 40.33 ^d | 38.56 ^e | 39.90 ^b | 20.86 ^{bc} | 19.78 ^c | 16.33 ^d | 18.99 ^b | 546.00 ^{cd} | 556.09 ^{cd} | 376.93 ^e | 493.01 ^b | 14.35 ^c | 14.90 ^{bc} | 13.86 ^{cd} | 14.37 ^b |
| 200 | 36.46 ^{fe} | 35.10 ^f | 32.44 ^g | 34.67 ^c | 14.43 ^{ed} | 20.33 ^{cb} | 13.67 ^e | 16.14 ^c | 432.33 ^d | 583.00 ^c | 289.52 ^f | 434.95 ^c | 12.18 ^d | 15.03 ^b | 10.92 ^e | 12.71 ^c |
| 300 | 27.00 ^h | 26.70 ^{hi} | 23.89 ^j | 25.86 ^d | 12.13 ^{fe} | 16.50 ^d | 11.00 ^f | 13.21 ^d | 274.36 ^f | 383.88 ^e | 261.38 ^g | 306.54 ^d | 10.76 ^{ef} | 10.56 ^{fe} | 10.17 ^f | 10.50 ^d |
| Mean | 42.90 ^a | 40.91 ^b | 36.72 ^c | | 17.72 ^b | 20.94 ^a | 15.50 ^c | | 502.70 ^b | 617.11 ^a | 380.70 ^c | | 13.46 ^a | 13.93 ^a | 12.49 ^b | |

Means within a column having the same letters are not significantly different according to Duncan's Multiple Rang Test (DMRT) at 5% level.

Table (2) Effect of PP-333, irrigation periods and their interaction on aerial parts and roots fresh and dry weights of *Dodonaea viscosa* (L.) Jacq. transplant during 2006 and 2007 seasons.

| Irrigation periods every PP-333 treatments (ppm) | Aerial parts F.W. (g) | | | | Roots F.W. (g) | | | | Aerial parts D.W. (g) | | | | Roots D.W. (g) | | | |
|--|-----------------------|---------------------|---------------------|---------------------|--------------------|---------------------|--------------------|--------------------|-----------------------|---------------------|---------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| | 3 days | 6 days | 9 days | Mean | 3 days | 6 days | 9 days | Mean | 3 days | 6 days | 9 days | Mean | 3 days | 6 days | 9 days | Mean |
| First season: 2006 | | | | | | | | | | | | | | | | |
| 0.0 | 119.80 ^a | 116.10 ^a | 75.91 ^{cb} | 103.94 ^a | 18.88 ^b | 19.90 ^a | 17.50 ^c | 18.76 ^a | 35.64 ^b | 54.29 ^a | 33.19 ^{bc} | 41.04 ^a | 7.15 ^c | 11.78 ^a | 8.67 ^b | 9.20 ^a |
| 100 | 71.58 ^c | 86.73 ^b | 56.38 ^d | 71.56 ^b | 14.62 ^d | 19.31 ^{ab} | 11.36 ^e | 15.10 ^b | 27.10 ^d | 30.95 ^c | 18.36 ^e | 25.47 ^b | 6.73 ^{cd} | 8.56 ^b | 6.24 ^d | 7.18 ^b |
| 200 | 28.90 ^e | 46.78 ^{ed} | 18.88 ^f | 31.52 ^c | 5.38 ^{hg} | 8.79 ^f | 4.33 ^h | 6.17 ^c | 9.61 ^f | 17.68 ^{fe} | 7.27 ^g | 11.52 ^c | 2.25 ^f | 4.73 ^e | 2.19 ^f | 3.06 ^c |
| 300 | 18.15 ^f | 30.16 ^e | 9.43 ^g | 19.25 ^d | 3.10 ⁱ | 6.12 ^g | 2.78 ^j | 4.00 ^d | 7.84 ^g | 10.33 ^f | 5.48 ^h | 7.88 ^d | 1.53 ^g | 2.18 ^f | 1.46 ^g | 1.72 ^d |
| Mean | 59.61 ^b | 69.94 ^a | 40.15 ^c | | 10.50 ^b | 13.53 ^a | 8.99 ^c | | 20.05 ^b | 28.31 ^a | 16.08 ^c | | 4.42 ^b | 6.81 ^a | 4.64 ^b | |
| Second season: 2007 | | | | | | | | | | | | | | | | |
| 0.0 | 108.00 ^b | 144.61 ^a | 86.81 ^c | 113.14 ^a | 24.33 ^b | 26.15 ^a | 18.93 ^c | 23.14 ^a | 49.71 ^b | 63.00 ^a | 39.76 ^c | 50.82 ^a | 8.49 ^c | 13.29 ^a | 8.79 ^c | 10.19 ^a |
| 100 | 64.55 ^d | 107.89 ^b | 64.48 ^d | 78.97 ^b | 18.36 ^c | 25.07 ^a | 12.20 ^d | 18.54 ^b | 37.69 ^{cd} | 37.35 ^{cd} | 29.10 ^d | 34.71 ^b | 6.38 ^d | 12.03 ^b | 5.68 ^{ed} | 8.03 ^b |
| 200 | 26.08 ^g | 58.26 ^e | 21.63 ^{hg} | 35.32 ^c | 7.65 ^e | 11.40 ^{de} | 4.76 ^f | 7.94 ^c | 12.33 ^f | 21.43 ^e | 9.53 ^g | 14.43 ^c | 2.68 ^g | 5.65 ^e | 2.25 ^{hg} | 3.53 ^c |
| 300 | 17.33 ^h | 37.46 ^f | 10.93 ⁱ | 21.91 ^d | 4.29 ^{fg} | 7.93 ^e | 3.08 ^h | 5.10 ^d | 7.50 ^{hg} | 12.36 ^f | 4.98 ^h | 8.28 ^d | 1.50 ^h | 4.00 ^f | 1.50 ^h | 2.33 ^d |
| Mean | 53.99 ^b | 87.06 ^a | 45.96 ^c | | 13.66 ^b | 17.64 ^a | 9.74 ^c | | 26.81 ^b | 33.54 ^a | 20.84 ^c | | 4.76 ^b | 8.74 ^a | 4.56 ^b | |

Means within a column having the same letters are not significantly different according to Duncan's Multiple Rang Test (DMRT) at 5% level.

Response of Dodonaea viscosa (L.) Jacq. transplants to
