Effect of NPK fertilizer and compost on the growth and development of two *Buxus sempervirens* cultivars 'Elengantissima' variegated and 'vader valley'.

By

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Abstract:

This study was carried out in the lath house of Agriculture College, Duhok University, Kurdistan region, Iraq, during the period between 17th August 2015 and 3rd May 2016. The experiment aimed to evaluate the effect of three levels of NPK fertilizers low (180, 90, 60), medium (270, 180, 120) and high level (540, 270, 180) $mg.l^{-1}$ and three level of local compost (0, 50 , 100) on two cultivars of *Buxus sempervirens* 'Elegantissima' variegated and 'vader valley' .The results summarized as follow: High level of NPK had significant effect on plant height, plant growth index, nitrogen and potassium percentage, whereas the branches number, plant leaf area were decreased with the high level of NPK. The media which consist of 100% compost gave significantly the highest values of plant height, branches number, Plant growth index, plant leaf area, Potassium and phosphor percentage when compared to media with 0% compost. Generally the best interaction between the three factors which gave the highest significant

values of plant height (61.25) cm was for Elegantissima cultivar which grew in 100 % compost and fertilized with high NPK level, whereas the highest plant growth index (18660) cm^3, potassium percentage (5.14) and plant leaf area (32321) cm^2 were for the same cultivar at 100% compost and medium level of NPK, While the highest branches number was for vader valley cultivar at all compost percentage and received medium and high level of NPK.

Keywords: Buxus; nitrogen fertilizer; compost;

Introduction:

Buxus sempervirens is belonging to the family Buxacece, its common name is Box or Boxwood **(Dickson, 2009)**. Its native Europe, northwest Africa, Morocco, and Mediterranean region to Turkey **(Rushforth, 1999).** They are slow growing broadleaf, evergreen shrubs, its twigs are densely and the leaves are ovate, entire, smooth, thick and small 1.5- 5 cm long and 0.3- 25 cm width, the flower are small and yellow to green and the fruit is capsules containing several seeds (**Koch and Ensikat, 2008; Dickson, 2009)**.

a boxwood is slow grow plant, it produce only single flush or growth in the spring after then enter into the dormancy period, this phenomenon exist in any plants containing meristem in their structure due to some external factors like temperature, moisture, availability of nutrients which is called eco-dormancy which include three types, thermal dormancy as a result to low or high in temperature, hydrational dormancy for moisture content or draught and nutrient deficiency (nutritional dormancy).The second type

called endo-dormancy that happen due to some physical factors in plant itself for example chilling requirement, the third type named para-dormancy is regulated by some physical factors outside the dormant form like apical dormancy, existing auxin hormone in apical buds which prevent lateral buds to grow (**Lang *et al*., 1987)**. **Bilderback and cartwright (1980**) founds that application of 4.1 kg/cu m of Osmocote slow release fertilizer of several to media consist of (2 hardwood bark : 1 sand) was more compelling encouraging growth of Japanese boxwood So it is possible that with limited nutrition, boxwood could undergo summer "dormancy" as a reaction to deficiency (nutritional eco-dormancy) then it is necessary to ascertain the appropriate levels of N, P and K application for the boxwood in order to achieve optimal growth. So if any of this primary macronutrient are limiting, boxwood could experience nutrient deficiency, a lack of growth, and even decline.

Organic matter improve the physical and chemical properties and more suitable for the growth and activity of microorganisms in the soil and the most important of which is good drainage and aeration and water-holding capacity (**Cabrera 2003; Al Sahaf, 1989)**. In addition, attribute in improving the physical characteristics of the soil such as porosity and tissues soil and water holding capacity **(Nyamangara. *et, al*, 2001).**

As the Boxwood plant are very important and use in wide range for coordinating gardens and general parks this experiment are designed to obtaining best media for their growth and maintaining in best condition for the rest period

of their life and to determine if summer dormancy of boxwood can be removed via nutrition treatments .

Material and Methods

This study was carried out during the period between 17th August 2015 and 3rd May 2016 in the lath house of Agriculture College nursery, Duhok University, Kurdistan region, Iraq. The experiment was performing to study three factors which include: NPK fertilizer with three level (180: 90: 60), (360: 180: 120), (540: 270: 180) $mg.1^{-1}$ through adding 100 ml each 15 days to each pot. Three levels of local composed prepared by mixing (sawdust: sheep manure: lawns clipping: hay) by equal volume (0% compost (River soil only), 50% Compost and 100% Compost (soilless)). And the third factor is two Buxus cultivars, *Buxus sempervirens* 'Elegantissima' variegated and 'vader valley'.

Rooted cuttings with 3 months age of two cultivars transplanted at 20th August 2015 in pots size (3) Liter by use media which consist of three levels of compost .the chemical characteristics of the three media are as in table (1).

Table (1): Some chemical characteristics of the media.

media	Local compost %	pH	Ec $ds.m^{-1}$	$caco_3$ %	k $mg.l^{-1}$	p $mg.l^{-1}$	N $mg.l^{-1}$	C/N Ratio	Organic mater
1	0% compost (River soil only)	8.3	0.2	19	27	5	840	27	1.17
2	50% compost	8.4	0.3	15.0	109.0	70.0	800.0	21.0	1.4
3	100% compost	8.4	0.4	10	190	119	770	16	1.62

The measurements which have been recorded (at the end of experiment at 3rd May 2016) are Plant height (cm), Branches number, Total leaf area (mm^2), Total chlorophyll content (SPAD) By using SPAD meter (Felixon and Nin, 2000), Nitrogen percentage in the plants According to **(Black 1965),** Phosphor percentage According to **(Matt, 1975)** by using spectrophotometer instrument and potassium percentage According to **(Richard, 1954)** by using flame photometer instrument and Plant growth index (cm^3) which calculated according to **Hidalgo (2001)** by the formula:

Plant growth index (cm^3) = 3.14 [1/2 ×(less width + large width)/2]^2 ×plant height.

The experiment consisted of three factors 3×3×2= 18 treatments each treatment consist of three replication and each replicate consist of four plants, The experiment were performed by using (RCBD) design and analyzing data via SAS program , and the means comparison was done by Duncan's Multiple Ranges test under 0.05 which was claimed by **(SAS ,2001).**

Results and discussion

1- Vegetative characters

The data in the table (2) showed that increased the NPK fertilizer from low level (180N, 90P, 60K) $mg.l^{-1}$ to high level (540N, 270P, 180K) $mg.l^{-1}$ caused significantly increased in the plant height from 32.82 to 35.51 cm and plant growth index from 6350 to 8598 cm^3 whereas the branch number and total leaf area needed only the medium level to increased significantly (4.68 branch/plant and 30773mm^2) when compared with the high level (4.12 and 24054) for the two character respectively. Also increased

the compost percentage in media from 0% (river soil only) to 100% (compost which consist of 25% sawdust: 25% sheep manure: 25% lawns clipping: 25% hay) caused significant increase in the plant height and total leaf area from 31.46 cm, 23192 cm^2 to 36.61 cm, 32131cm^2 for the two characters respectively. Although there are no significant deference between the second and third level of compost on branches number and plant growth index when compared with each other the third level gave the highest significant means for the two characters when compared them with the control treatments.

In the other hand *Buxus sempervirens* "Elegantissima variegated"cultivar was significantly superior in plant length, plant growth index and total leaf area whereas the Vadar Valley was significantly superior in branches number when compared each with other.

Table (2). Effect of NPK fertilizer and compost on some vegetative characters of two cultivars of boxwood (*B. sempervirens*) plant.

Characters	NPK effect			compost effect			Cultivar effect	
	Low	Medium	High	0	50	100	Elegantissima	Vadar Valley
plant length	32.82^{b}	33.36^{ab}	35.51^{a}	31.46^{b}	33.63^{b}	36.61^{a}	53.97^{a}	13.82^{b}
Branches number	4.45^{ab}	4.68^{a}	4.12^{b}	4.13^{b}	4.43^{ab}	4.70^{a}	3.75^{b}	5.09^{a}
plant growth index (cm^3)	6350^{b}	6557^{b}	8598^{a}	6034^{b}	7195^{ab}	8276^{a}	13671^{a}	666^{b}
total leaf area (mm^2)	27778^{b}	30773^{a}	24054^{c}	23192^{c}	27282^{b}	32131^{a}	31482^{a}	23587^{b}

Means with same letter for each factor and each character are not significantly different at 5% level based on Duncan's Multiple Rang Test. *Low (180, 90, 60), medium (360, 180, 120), High (540, 270, 180)$mg.^{l-1}$.

The data in table (3) showed that the triple interaction between NPK fertilizer, compost and cultivars indicated that the Elegantissima cultivar plants which grew in the media which contain 100 % compost and fertilized with the three level of NPK gave the highest value of plant height 59.50, 55.17, 61.25cm respectively compared with the least value (46.17) cm for the same cultivar but at 0% compost and fertilized with the low level of NPK (180, 90, 60) $mg.l^{-1}$, and 12.50 cm for Vadar Valley cultivar which grew in 50% compost and fertilized with the high NPK level (540, 270, 180) $mg.l^{-1}$. Whereas the more significant branch number which were ranged between (5.00 to 6.08) branch/plant for the vader valley cultivar that grew in all compost level and fertilized with low and medium NPK level compared the less number 3.08 for Elegantissima cultivar that grew in 0 compost and fertilized with the low NPK level (180, 90, 60) $mg.l^{-1}$ branch/plant.

Table (3). Effect of the interaction among NPK fertilizer and compost on some vegetative characters of two cultivars of boxwood (*B. sempervirens*) plant.

Cultivars	NPK level	compost %	plant height (cm)	branch number	plant growth index (cm^3)	total leaf area (mm^2)
Elegantissima	Low	0	46.17^{c}	3.08^{d}	9768^{e}	31669^{b}
		50	50.17^{bc}	3.28^{cd}	11694^{c-e}	33273^{b}
		100	59.50^{a}	3.92^{b-d}	14680^{bc}	37353^{a}
	Medium	0	49.25^{bc}	3.75^{cd}	11156^{de}	26847^{de}
		50	52.42^{bc}	3.47^{cd}	12137^{c-e}	32531^{b}
		100	55.17^{ab}	4.00^{b-d}	14026^{cd}	39630^{a}

	High	**0**	52.58^{bc}	3.81^{b-d}	13507^{cd}	25408^{d-f}
		50	59.25^{a}	4.00^{b-d}	17410^{ab}	24307^{d-f}
		100	61.25^{a}	4.44^{bc}	18660^{a}	32321^{b}
Vadar Valley	**Low**	**0**	13.33^{d}	5.03^{ab}	544^{f}	16296^{h}
		50	13.58^{d}	5.75^{a}	687^{f}	20550^{g}
		100	14.17^{d}	5.67^{a}	729^{f}	27523^{cd}
	Medium	**0**	14.67^{d}	5.00^{ab}	629^{f}	23869^{ef}
		50	13.83^{d}	5.78^{a}	635^{f}	29991^{bc}
		100	14.83^{d}	6.08^{a}	758^{f}	31771^{b}
	High	**0**	12.75^{d}	4.11^{b-d}	601^{f}	15063^{h}
		50	12.50^{d}	4.28^{b-d}	609^{f}	23037^{fg}
		100	14.75^{d}	4.08^{b-d}	805^{f}	24186^{ef}

Means with same letter for each character are not significantly different at 5% level based on Duncan's Multiple Rang Test. *Low (180, 90, 60), medium (360, 180, 120), High (540, 270, 180).

In the same table the triple interaction between the three factors showed that the Elegantissima cultivar plants which grow in media which contain 100% compost and fertilized with high NPK level (540, 270,180) $mg.l^{-1}$ gave the highest value of plant growth index reached 18660 cm^3 compared to the vader valley cultivar 805 cm^3 which gave the least value and grew in 100% compost and fertilized with high NPK level.

also the highest values (37353 and 39630 cm^2) of total leaf area were for Elegantissima plants which grew at 100% compost and fertilized with low and medium levels respectively, whereas the less value (15063 cm^2) was for vadar valley plants which grew at 0% compost and fertilized with the high levels of NPK

2- Chemical characters

The data in the table (4) showed that increased NPK levels haven't any significant effect on the total chlorophyll content and phosphor percentage characters whereas they effect significantly on nitrogen and potassium percentage and the highest values reached 0.289% and 3.68% when fertilized with the high level (540, 270,180) $mg.l^{-1}$ compared with the lowest value (0.198%, 3.27%) for low level. Also the compost factor take the same direction and it haven't any significant effect on the total chlorophyll content and nitrogen percentage while it effect significantly on phosphor and potassium percentage and the highest value which reach 3.46% , 3.83% were for soilless treatment (100%) compared with other treatment.

As shown in the same table the two cultivars were significantly difference and the *Elegantissima* cultivar was superior in total chlorophyll, nitrogen and potassium percentage (65.69 spad, 0.282%, 4.28% compared with *vader valley* which gave (41.80 spad, 0.216%, 2.72%) respectively whereas the *Elegantissima* cultivar was significantly decreased in phosphorus percentage and gave 2.65% in contrast to 3.31% for *vader valley* cultivar.

Table (4). Effect of NPK fertilizer and compost on some chemical characters of two cultivars of boxwood (*B. sempervirens*) plant.

Characters	NPK effect			compost effect			Cultivar effect	
	Low	Medium	High	0	50	100	Elegant issima	Vadar Valley
total Chlorophyll (SPAD)	54.39[a]	52.98[a]	53.86[a]	54.68[a]	53.82[a]	52.74[a]	65.69[a]	41.80[b]
nitrogen %	0.198[b]	0.259[a]	0.289[a]	0.223[a]	0.257[a]	0.266[a]	0.282[a]	0.216[b]

phosphor %	2.84[a]	3.12[a]	2.97[a]	2.60[b]	2.87[b]	3.46[a]	2.65[b]	3.31[a]
potassium %	3.27[b]	3.55[a]	3.68[a]	3.16[c]	3.51[b]	3.83[a]	4.28[a]	2.72[b]

Means with same letter for each factor and character are not significantly different at 5% level based on Duncan's Multiple Rang Test. *Low (180, 90, 60), medium (360, 180, 120), High (540, 270, 180).

The data in table (5) showed that the triple interaction between NPK fertilizer, compost and cultivars indicated that the Vadar Valley cultivar plants which grew in all fertilizer level and all compost level gave the highest values of total chlorophyll content ranged between (59.50 to 71.50) spad while the lowest value was 38.48 spad for the Elegantissima cultivar which grown in media contain 50% compost and fertilized with high NPK fertilizer.

Table (5). Effect of the interaction among NPK fertilizer and compost on some chemical characters of two cultivars of boxwood (*B. sempervirens*) plant.

Cultivars	NPK level	compost %	Total chlorophyll content (SPAD)	nitrogen %	phosphor %	potassium %
Elegantissima	Low	0	39.42[d]	0.140[d]	2.17[e]	3.79[c-d]
		50	44.82[b-d]	0.233[b-d]	2.66[d-f]	3.98[b-c]
		100	41.63[cd]	0.280[a-d]	3.02[c-f]	4.46[a-c]
	Medium	0	42.34[cd]	0.308[a-d]	2.33[ef]	3.69[de]
		50	44.84[b-d]	0.233[b-d]	2.75[d-f]	4.69[ab]
		100	43.40[cd]	0.266[a-d]	3.01[c-f]	4.54[ab]
	High	0	40.27[d]	0.327[a-c]	2.63[d-f]	3.59[de]
		50	38.48[d]	0.420[a]	2.53[d-f]	4.65[ab]
		100	40.98[d]	0.327[a-c]	2.72[d-f]	5.14[a]
Vadar Valley	Low	0	68.49[a]	0.210[b-d]	2.68[d-f]	2.35[g]
		50	67.77[a]	0.187[b-d]	2.78[d-f]	2.23[g]
		100	64.23[a]	0.140[d]	3.75[a-c]	2.80[fg]

	Medium	0	66.04^{a}	0.163^{c-d}	3.25^{b-d}	2.61^{fg}
		50	61.74^{ab}	0.233^{b-d}	3.35^{b-d}	2.54^{fg}
		100	59.50^{a-c}	0.350^{ab}	4.03^{ab}	3.27^{d-f}
	High	0	71.50^{a}	0.191^{b-d}	2.57^{d-f}	2.95^{e-g}
		50	65.25^{a}	0.233^{b-d}	3.17^{c-f}	2.98^{e-g}
		100	66.68^{a}	0.233^{b-d}	4.21^{a}	2.78^{fg}

Means with same letter for each character are not significantly different at 5% level based on Duncan's Multiple Rang Test. *Low (180, 90, 60), medium (360, 180, 120), High (540, 270, 180).

The triple interactions between NPK, compost and cultivars increased the nitrogen percentage significantly and the highest value (0.420) % was for the Elegantissima cultivar which grown in media contain 50% compost and fertilized with the high NPK level whereas the less value (0.140) % was for the same cultivar which grown in 100% compost and fertilized with low NPK level.and Vader Valley plants which grew at 100% compost and fertilized with the low NPK level.

the highest value of phosphorus for Vader Valley plants reached to 4.21when grew in 100% compost and fertilized with high NPK level compared to the higher Elegantissima plants value (3.02) % at low NPK level and 100% compost and with the less value 2.17 for the same cultivar which grown without compost and fertilized with the low NPK levels.

The triple interaction between NPK fertilizer, compost and cultivar affected significantly on potassium percentage and the highest value which reached 5.14 % was for Elegantissima plants which grew at 100% compost and fertilized with high NPK level, whereas the less value (2.23)

% was for Vader Valley which grew at 50% compost and fertilized with the low NPK level.

Increasing in plant height, plant growth index, nitrogen and potassium percentage with increasing the NPK fertilizer from low level to high level might explain due to the largely content of nitrogen which is necessary for protein synthesis and had more effect on elongation and multiplication of cell resulting in increased plant height. Or might be return to a consequence of nitrogen influence on photosynthesis, the amount of photo assimilates that are produced by the plant, dry matter partitioning then organ development (**Panchabhai *et al*., 2005; Dordas, 2009**). Or to the rule of nitrogen and its effect on increase the rate of cell division, metabolism, cell elongation by enhancing the apical meristem growth and more leaves were produced, while increasing potassium percentage may increase enzyme functions, energy relation, protein synthesis, nitrogen uptake, and translocation of assimilates due to existing of potassium in many enzymes including photo-synthesis, potassium ranged from 0.87 to 0.97 % at the upper most leaves of *Buxus sempervirens* 'Suffruticosa' **(Mills and Jones, 1996; Foth and Ellis, 1997).**

the media that contain 100% of compost which consist of equal volume of (sawdust: sheep manure: lawns clipping: hay) was the best media for increasing the plant height, branches number, plant growth index, total leaf area, Phosphor percentage and Potassium percentage significantly when compared with the other levels these results may refer to the high organic matter, potassium and phosphor of this media as shown in table (1) which are responsible for improving the chemical and physical characters and have

ability to hold nutrients for longest period that necessary for plant growth cycle and this kind of media due to more holding water capacity and richer with minerals (**Sonneveld and Voogt, 2009).**

The deference between *Elegantissima* and *Vader valley'* cultivar may back to different cultivars had different gynotype , genetic factors , also nutritional state of plants , responding of plants to different treatments , environmental variable factors as proven by (**Svecov and Neugebauerov, 2010).** Also these results might attributed to the positive correlation between most of the growth characteristics as in table (6)

Table (6). Correlation between the studies characters for the first experiment:

	plant high	**branches number**	**total chlorophylls**	**total leaf area**	**plant growth index**	**nitrogen %**	**potassium %**
branches number	-0.612**						
total chlorophylls	0.981**	-0.544**					
total leaf area	-0.810**	0.467**	-0.783**				
plant growth index	0.580**	-0.385**	0.513**	-0.515**			
nitrogen %	-0.450**	0.356**	-0.423**	0.230*	-0.411**		
potassium %	0.841**	-0.518**	0.832**	-0.623**	0.452**	-0.320*	
phosphous %	0.613**	-0.202	0.570**	-0.537**	0.328*	0.608	0.045**

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