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Effect of Vector and Location on Sunburn (Abiotic Disease) Seen on Paulownia Trees (*Paulownia Tomentose*)

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Abstract **– In this study, effects of vector and location of sunburn seen on paulownia trees which were planted in 2004, numbered as 636, on campus of Dicle University, have been researched. In observations, effects of sunburn increased depending on how stem of paulownia sees the direct light of sun. There is an inverse ratio between the sunburn and stem-thickening. While the least disease and the most stem-thickening have been observed on the trees which were planted in South-North direction, the most disease severity has been observed on the trees planted on the front rows in Northwest-Southeast direction. With this combination, intensity of disease has increased 18 times and stem-thickening decreased %62 compared to previous one. As the result of this work, deep-rooted paulownia is seen an alternative of superficial-rooted poplar. The climate and the soil condition in the region of Diyarbakir, we can say works quite well for paulownias but low moisture level increases the level of sunburn seen on paulownia stems in the summers. To prevent the sunburn, stem of paulownia can be protected by using the white-colored foam board.**

Keywords **– Paulownia, Abiotic Disease, Sunburn.**

I. INTRODUCTION

Paulownia (*Paulownia tomentose*); is called "the empress" and the "princess" and grows naturally in China (**Remaley, 2005**). It is a very old plant which grows rapidly, is deeply rooted, blossoms in April, has a habitus of regular and loose form, large leaves, purple flowers, loves calcareous soil, and has plenty of light and sunshine in sea coast and salty soil (**Orçun, 1975**). The raw material of the paper is started to be cut according to the growing conditions from the 5th year in terms of the cellulose industry. Exactly 12 times more can be exiled from the same root after cutting (**http://www.paulowniaci.com**).

Paulownia has been cultivated in China since about 2600 years. Today in the world around 24 million acres, the Paulownia tree farming is done for various purposes. The varieties of Paulownia are widely grown in Laos, Vietnam, Korea, Japan, and in the last 15 years in the US, South America, New Zealand and Australia. (**http://www.paulowniaci.com**). The Paulownia Sieb. & Zucc type of *Paulownia*, which has a large number of species, started to take place in forestry among the very fast growing species in Turkey's forest industry (**Ayan et al., 2006**). As the leaves are used as green fertilizer and animal feed, the flowers are very suitable for beekeeping. Most importantly, it seems to be an alternative with its deep roots to the surface-rooted and more water dependent brace to the paper and lumber industry (**Turner et al., 1988, http://www.paulowniaci.com**).

Especially in seedlings and young age, fungal factors mostly originated from soil are a problem in biotic disease factors (**Hsieh, 1983**). Records of abiotic factors are rather limited. In an observation made in Panama, young paulownia tree bodies were sunburned in the sun, while grassland or whitewash painting near the soil reduced damage (**Anonymous, 2009**).

In this study, the influence of the vector and location on sunburn disease on 636 Paulownia (*Paulownia tomentose*) trees planted on the roadside and green field in 2004 at the Dicle University Campus was investigated.

II. MATERIAL AND METHOD

2.1. Material

The study was conducted on 632 Paulownia (Paulownia tomentose) trees planted in 2003 on the roadside and green field in the Dicle University Settlement. The direction and location of the planted trees are made use from "Google Maps" (**http://maps.google.com/maps**).

2.2. Method

The paulownia trees in different vectors and locations have 3 repetitions in "Randomized Blocks Experiment" design and effects of two factors, namely, the development of the mentioned plant and the severity of disease, direction and location have been mentioned (**Açıkgöz, 1988**).

The trees have been placed in experimental design according to their order along the roadside, the central refuge and the ground; They are placed in four directions as North-South, East-West, Northwest-Southeast and Northeast-Southwest or close to them (**http://maps.google.com/maps**).

Pre-planted trees in four different directions have been divided into two groups according to their utilization status of Sun. These groups have been placed in the experiment as the ones in the front row and the ones in the back row.

2.2.1. Measurements and observations made in the study

2.2.1.1. The present state of the paulownia tree: If the vitality of the pre-planted tree stood as if it had been planted **"1"**, if the first body died but the bottom shoot was left with vitality and the body was transformed into a body shape **"2",** and if this second body dried and left its place to the shoot then it was considered as **"3" (Picture 2.1).**

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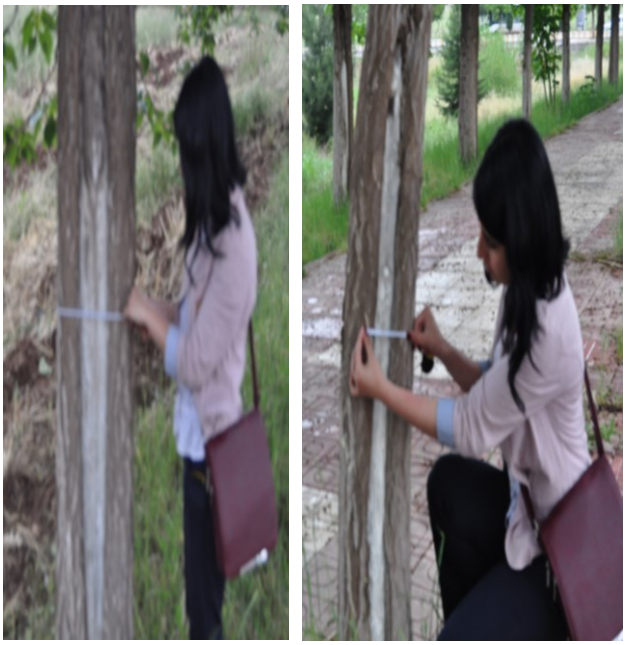
Picture 2. 1. Present state of the Paulownia tree. On the left, the body of the pre-planted body stood(1) ;in the middle, the body of the first planted tree died (2); on the right the shoot which came out from the first planted tree and itself died (3).

2.2.1.2. Body development (cm): The tree trunk circumference (circle) was measured from a height of one meter above the ground or by a tape measure from this area if a burn occurred (Picture 2.2).



Picture 2. 2. Determination of body development (left) and sunburn (right)..

2.2.1.3. Determination of sunburn area at the body (cm): The widest length (beam or bow) that has died from burning was found by measuring again with plastic tape measure (Picture 2).

2.2.1.4. Sun burn rate:

The above burn is the ratio of length to the tree circumference.

2.2.1.5. Sunburn intensity (scale):

It is the value found by adding the rate of burns found in a tree to the number of dead trees previously located in the same place.

III. Findings and Discussion

3.2.1.1. Whether the present condition of the Pauline tree is or is not preserved:

The mean values of measurements and observations made between 10.04 - 03.05 / 2013 are given in Table 1. When the chart was examined, it was seen that during the observation, the trees were preserved in the North-South direction as they were first planted. This was followed by East-West, Northeast-Southwest directions. The last place was the northwest-southeast direction. The mean values obtained were found to be significant at the 5% level.

The Paulownias in the rear position are more protective of their initial situation than the trees planted in the front with more sunshine in the directions discussed (Table 3.1).

Table 3. 1. Effect of Vector and Location on Sunburn (Abiotic Disease) of Body seen on Paulownia (2013).

Application	**Body Nr.**	**Body Development** (Circumference ,cm)	**Sunburn** (cm)	**Ratio**	**Scale**
Vector	*	**			**
North-South	1.077**C**	70.462 **A**	5.797	0.107	0.183 **B**
East-West	1.182 **BC**	69.580 **A**	6.092	0.093	0.275 **B**
Northwest-Southeast	1.495**A**	42.868 **AB**	6.912	0.185	0.795 **A**
Northeast-Southwest	1.427 **AB**	33.955 **B**	5.048	0.182	0.632 **AB**
Location			*	**	**
Front	1.400	48.302	7.833	0.187	0.648
Back	1.190	60.131	4.091	0.097	0.294
Vector X Location					
North – South (Front)	1.123	60.263	9.477	0.180	0.303
North – South (Back)	1.030	80.660	2.117	0.033	0.063
East – West (Front)	1.310	65.617	7.840	0.130	0.440
East – West (Back)	1.053	73.543	4.343	0.057	0.110
Northwest - Southeast (Front)	1.693	30.650	8.353	0.207	1.120
Northwest - Southeast (Back)	1.297	55.087	5.470	0.163	0.470
Northeast-Southwest (Front)	1.473	36.677	5.663	0.230	0.730
Northeast-Southwest (Back)	1.380	31.233	4.433	0.133	0.533
*) significant to 0,05, **) significant to 0,01					

When the vector and location are examined together, compatibility with the above is seen. The trees in the north-southward directions, in the best way, protected their present state, whereas the first row in the northwest-southeast direction, that is, the trees which obtain more sunshine, are the last to maintain their current state (Table

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3.1, Figure 3.1).

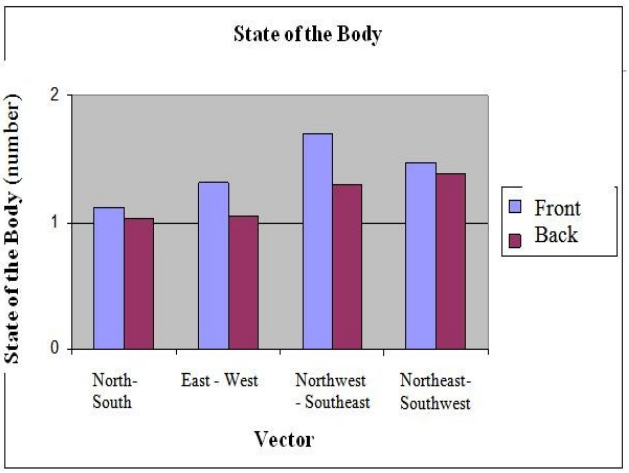

Fig. 3. 1. Effect of vector and location of body state.

3.2.1.2. Body development (cm): In the light of what has been described above, the trunk development of the paulownia trees was interrupted by the direct solar influence, and the effect of the vectors on the body trunk development was found to be statistically significant at the level of 1%. As the sun moves away from the direct effect, the body thickening increases. The mean trunk circumference of the back side trees was 60 cm, while the average value of the front side trees was 48 cm (Table 3.1). The combination values of vector and location is given in Figure 3.2.

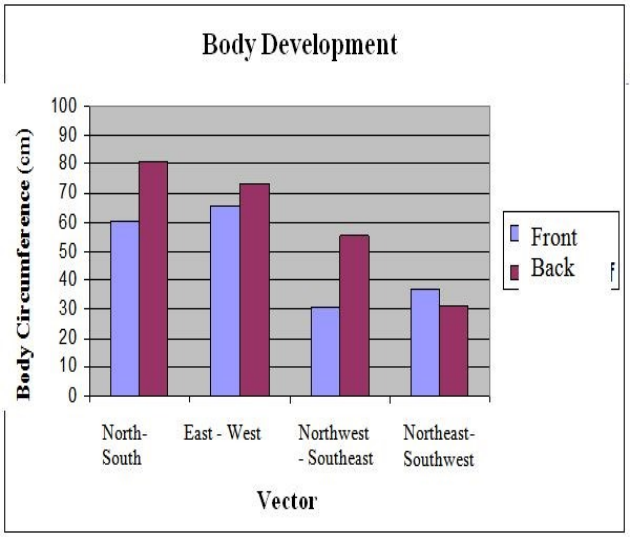

Fig. 3. 2. Effect of vector and location on body development

3.2.1.3. Determination of sunburn area at the body (cm): Deaths were observed in the shells of sunbathing days in Paulownia tree with more sunlight. In the environmental measurements of these dead areas, these values were found to be higher in the trees planted in the front than in the rear row or the position, and the results were significant at 5% (Table3.1). The mean values of the vector-location combination plots are given in Figure 3.3.

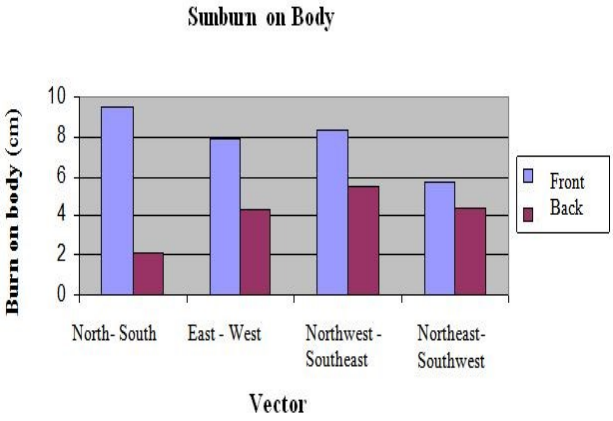

Fig. 3. 3. Effect of vector and location on sunburn on body.

3.2.1.4. Sun burn rate: When the ratio of the burn area width to body circumference is taken into consideration, this value is higher in the paulownia body that receives more sun. The location is of importance at 1% level (Table 3.1). The average rate on the front side is about 2 times that of the back side. The mean values of the vetor-location combination plots are given in Figure 3.4.

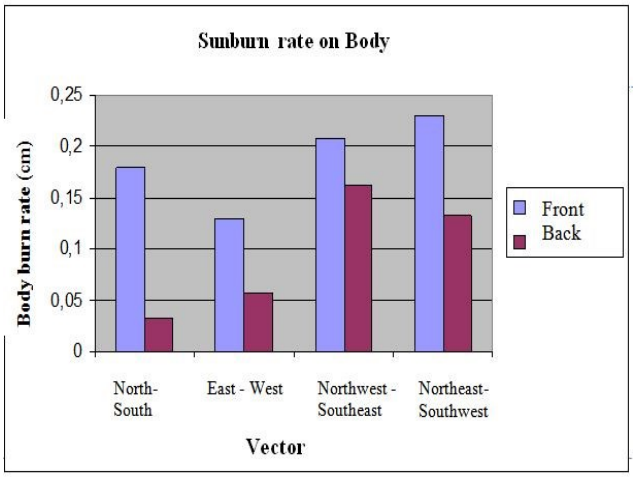

Fig. 3. 4. Effect of vector and location on sunburn rate.

3.2.1.5. Sunburn severity (scale): The scale values found by adding the percentage of burns found in a tree to the number of dead trees previously found in the same place, in other words, the "Severity of Disease" averages are summarized in Table 3.1.

When directions are taken into account, there is a negative correlation between body thickening and disease severity. In the statistical analysis, the results were found to be significant at the 1% level. The lowest value in the North-South stitched trees where the highest trunk thickening (70.462 cm) was detected was calculated as 0.183. The highest disease severity was determined in the "Northwest-Southeast" direction (0.795). With this application, the severity of disease has increased by about 4.5 times. In other respects, trunk thickening decreased by 40% compared to the previous one (Table 3.1, Figure 3.5, Figure 3.6).

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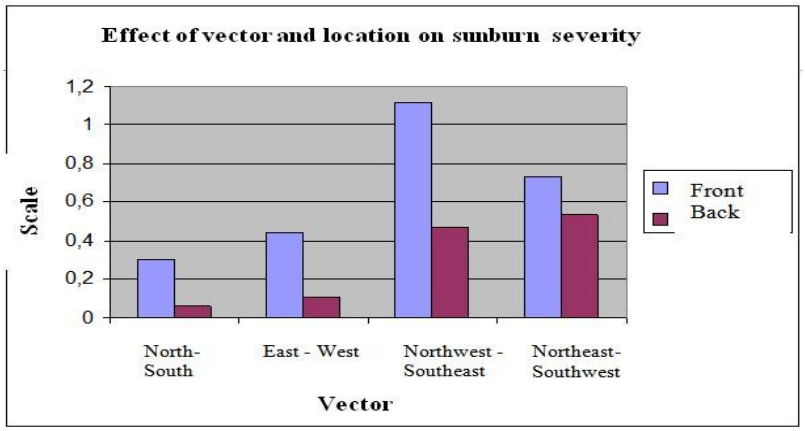

Fig. 3. 5. Effect of vector and location on sunburn severity.

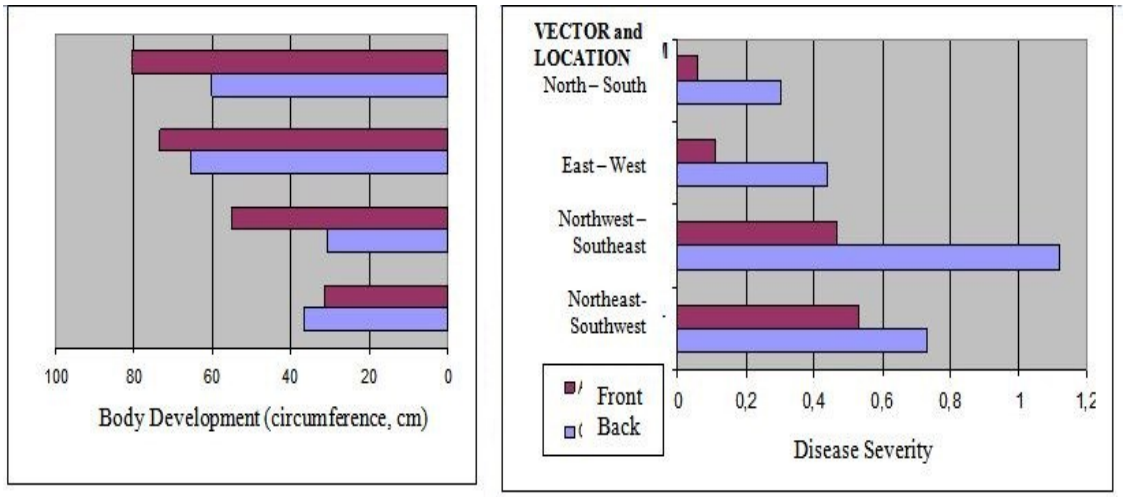

Fig. 3. 6. Effect of vector and location on body thickening and sunburn disease severity of paulownia.

The results were found to be significant at 1% level. Again, a reverse correlation between body thickening and disease severity is immediately apparent. In the posterior position where the highest body thickening (60.131 cm) was detected, the lowest disease scale value in the planted trees was calculated as 0.294. The highest sunburn value at the front of the body with at least thickening of the body (48.302 cm) was calculated as 0.648. The disease severity increased by 2.2 in this position and the trunk thickening decreased by 20% (Table 3.1).

When the combination of vector and location was considered, the disease severity was found the least 0.063 in the trees planted in the back row in North-South direction (Picture. 3.1). However, in this combination the trunk thickening was the highest at 80,660 cm. The highest disease severity was in the order of 1.120, in the Northwest-Southeast direction, in front-row planted trees. Previously, in this vector and location, the minimum circumferential body thickness was found to be 30.650 cm. Here, the severity of the disease is approximately 18 times. On the contrary, trunk development decreased by 62%. Tree images in other directions and locations are given in Picture 3. 2 and 3.3.

Picture 3.1. Effect of vector and location of paulownias on paulownias development: On the left, back row paulownia tree on North – South direction (pine three on the front was planted 22 years before the paulownia); on the right, back row paulownia trees on Northwest – Southeast direction (the ones on the back row were more effected from the sun when the most of the ones on the left row died, Photo: 16.04.2013).

Picture 3. 2. Effect on vector and location of paulownias on paulownia development: in East – West direction in the back (the building on the left shadowed) and paulownias tress in the front (on the right) location (Photo : 16.04.2013).

IV. Conclusions and Suggestions

The climate and soil conditions of the Diyarbakir region are very suitable for Paulownia. However, due to the high summer temperatures and the low temperature of the sun, there is "burning" due to excessive water loss in the body that is directly exposed to the sun.

According to our findings, the severity of the burning of the tree body has increased to the extent is receives sun. Particularly during the young age, burning in the trunk of the shell caused the death of the stem of the phloem transmission bundle. This is due to the fact that the sun caused the deeper pathways leading to deaths in the xylem pipes.

In the cambial region, transport of water and minerals from the soil to other organs and photosynthesis from the leaves to the roots were prevented by the death of these transmission bundles, the most important organ of the plant. In this case tree development slowed down and then died.

It is important that we take the following precautions in the light of these explanations.

1- In view of the opinions of the experts, the conditions of Diyarbakir must be observed for the cultivation of Paulownia.

2- Polyurethane tree guards may be placed to protect the region from excessive sunbathing during the planting phase or young period of the paulownia tree. With this method, in the forestation of natural areas by means of landscape, tree body sunburn and damages of naturally living creatures would be prevented as well.

3- Landscape architecture does not include pruning unless it is naturally necessary. As a result of mistakenly cutting branches that can be reached in the body as pruning in the region, it causes more sun burns due to the nakedness of the body (Figure 5.1). Most of these cutting operations are using hand brush hooks or axes instead of saw blades and scissors. This process, which is wrong, should be done at the control of the experts.

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