Effects of Some Dates, Pre-treatment Sowing, Soil Texture and Foliar Spraying of Zinc on Seedling of *Dalbergia sissoo* (Roxb.)

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***Abstract*—Three experiments were conducted from the beginning of March to the end of October, 2012, in a field condition in Koya city-Iraqi Kurdistan region on shisham *Dalbergia sissoo* (Roxb.) trees. First experiment was laid out to study the effects of three date of sowing (15 of March, April and May), and six pre- treatments on seed germination of *D. sissoo* (Roxb.). The Results show that the best time of sowing for good seed germination was 15 of April. Highest germination rate was found when both sides of the pod were cut with soaking in tap water for 24 h. Second experiment was conducted to study the effects of three transplanting soil textures (clay, sandy and sandy clay (1:1) on seedling survival and some growth characteristics. Results indicates that *D. sissoo* gave better seedling survive rate, seedling leaves and height in sandy clay and sandy soils compared to clay soil. Third experiment was laid out to study the effects of foliar application of zinc (0, 57 and 114 ppm) sprayed on *D. sissoo* plants growing in clay, sandy and sandy clay (1:1) soils. Zinc application caused a significant increase in most vegetative growth characteristics. Treatments significantly increased leaves phosphorus, sulphate and zinc content compared to control. Most promising results were obtained from seedlings sprayed with zinc and grown in sandy clay soil**.

***Index Terms*—Dalbergia sissoo, seeds germination, shisham, soil texture, Zn-spray.**

I. Introduction

Shisham *Dalbergia sissoo* (Roxb.) belongs to family Fabaceae, sub-family Faboideae (Saha, et al., 2013), it is deciduous tree with a light crown and is propagated by seeds and suckers, this tree can grow naturally up to 1500 m above sea level. The temperature in its native range averages 10 – 40°C, it can withstand average annual rainfall up to 2000 millimeters and 3–4 months of drought, it grows best in porous well-drained soils like sands, sandy loam, gravels, and alluvial soils, but grows poorly in heavy clay and waterlogged soils, shisham can grow in slightly saline soils. *D. sissoo* is one of the most common multipurpose species with value for its timber. Leaves, young shoots and green pods, are an important source of fodder. *D. sissoo* is widely used in urban and roadside plantings and erosion control; it's also one of the important sources of medicines. (Shaltout and Keshta, 2011; Lal and Singh, 2012; Bharath, et al., 2013).

Many studies were carried out for accelerating the germination and increase germination rate of *D. sissoo* hard seeds, such as, breaking the seed pod into several pieces, each containing 1-2 seeds, soak pods in tap water for at least 24 hours before sowing (Sheikh, Abdul Matin and Nasir Uddin, 2006; Singh and Kaushik, 2011). Extraction of seeds from the pods, sulphuric acid and dewinging were found to be the best treatments for dormancy breaking compared to soaking in hot or tap water or electric burner or extraction of seeds (Idrees and Mohammed, 2014). Sheikh and Abdul Matin (2007) showed that the required germination period for *D. sissoo* (Roxb.) was very short in seeds without coats (3-6 days) in relation to coated seeds (14-15 days).

D. sissoo seed germination and seedling growth affected by different soil media like clay, sandy, sandy clay and silty soils (Sah, et al., 2003; Singh and Kaushik, 2011). Webb and Hossain (2005) found that soil parameters had no correlation with *sissoo* mortality.

Without adequate levels of zinc, the plant is unable to synthesize the various enzymes and proteins. Zinc is a structural component of the ribosome (Dickinson, et al, 2003; Obaid and Al-Hadethi, 2013). Sulfur is another important element for healthy plant growth, it is an essential component

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in the synthesis of amino acids required to manufacture proteins (Salisbury and Ross, 1991).

This study was conducted because of the lack of information about *D.sissoo* trees in Iraq, limiting area cultivated with these trees, furthermore to increase this type of trees in different regions in new province of Kurdistan (Koya), the objectives of this study were to determine the most suitable time in field condition for seed sowing and best pre-treatment for best germination, the most suitable cultivating soil for best seedling growth, and finally to know the effects of foliar spraying of zinc on the growth, chemical constituents and some physiological characteristic of the seedling

II. MATERIAL AND METHODS

For conducting this study, the pods with one seed of *D. sissoo* trees cultivated in Mnara Park in Erbil governorate were collected on 6th March, 2012. Three experiments were conducted in a field condition in Koya city located at 44^{o}38 E, 36^{o}4 N and 517 m altitude above sea level, as follow:

A. *Effect of Time of Sowing and some Pre–treatments on D. sissoo Seed Germination*

A factorial experiment with randomized complete block design (R.C.B.D.) with three replicates was conducted to study the effect of three times of sowing, (15th March, April and May, 2012) and six pre- treatments on germination of *D. sissoo* seeds. Pre-treatments used includes: control or untreated pods, soaking pods in tap water at room temperature for 24 hours (Sheikh and Abdul Matin, 2007), cutting one side of the pods, cutting one side of the pods with soaking in tap water at room temperature for 24 h, cutting both sides of the pods, and cutting both sides of the pods with soaking in tap water at room temperature for 24 h.

Nursery box (50×30×30 cm) were used as seed beds by using sandy soil, each bed contain 50 seeds. The rate of seed germination was calculated by dividing the number of seedling by the total number of seeds multiplied by 100 (Ahmadloo, et al., 2012).

A. *Effect of Different Soil Textures on Seedling Survival Rate and some Vegetative Growth Characteristics of D. sissoo*

randomized complete block design experiment with three replicates was conducted to study the effect of three soil textures (clay, sandy and sandy clay 1:1) on seedling survival and some vegetative growth of *D. sissoo*, by transplanting 10 cm length seedling with 4-6 leaves in poly ethylene bags sized 10×10×30 cm on the first of June, 2012, the following characteristics were studies on the first of August, 2012:

- Rate of survival seedlings was measured by dividing the number of survival seedlings by the number of initial planted seedlings at transplanting time. (Kusmana, 2010).
- Number of seedling leaves.
- Seedling height (cm): It was measured from the point of stem attachment with soil to the apical point of the main shoot.

B. *Effect of Different Soil Textures and Foliar Spraying with Zinc on D. sissoo Vegetative Growth, Leaves Chemical Constituents and Some Stomata Characteristics*

A factorial experiment using randomized complete block design with three replicates was conducted on the first of August, 2012 to study the effects of three soil textures (clay, sandy and sandy clay 1:1) with three concentration of Zn (0, 57 and 114 ppm) and their combinations on vegetative growth, leaves chemical content and some stomata characteristics of *D. sissoo* seedlings. Spraying was carried out twice; first spray was done on 30th of August, while the second spray was 10 days after the first one. The spraying carried out early in the morning until all leaves on the target plants were wet.

C. *Studied Characteristics*

Vegetative Growth

This includes seedling height and leaves number, number of branches per seedling, leaf area which calculated by the method described by Watson and Watson (1953) and main root length.

Chemical Constituents of Leaves

This includes percent of shoot and root dry matter which were calculated as it described by Al-Sahaf (1989), total carbohydrates determined according to Joslyn (1970), chlorophyll content estimated according to Ranganna (1977), total nitrogen determined by kjeldahl method (Allen, et al., 1974), total phosphorus estimated by spectrophotometer at 410 nm as described by Ryan and Rashid (2001), total potassium determined by using flame photometer as it mentioned by Kalra (1998), total zinc determined by using atomic absorption spectrophotometer and using acetylene gas at 213.9 nm (A.O.A.C., 1970), and sulphate determined according to Gupta (2004).

Stomata Characteristics

Number, length and width of stomata in upper and lower surfaces of leaves measured by the method of lasting impressions as it described in Rai and Mishra (2013).

Meteorological Data and Soils Properties

Some meteorological data in the field condition during the growing season were measured in Agro-Meteorological Station in Koya city as it shown in Table I. Chemical and physical properties of the study soils are measured in the Agricultural Research Center-Ainkawa-Erbil, and University of Sulaimanya -Department of Soil and Water Science as it shown in Table II.

D. *Statistical Analysis*

The treatments of all experiments replicate three times, and the comparisons between means were made by using Duncan's Multiple Range test at 5% level (Reza, 2006). The statistical analysis was carried out by using SAS program.

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TABLE I
MAXIMUM AND MINIMUM TEMPERATURE, THE RELATIVE HUMIDITY AND THE AMOUNT OF RAIN FALL DURING THE GROWING SEASON (2012)

Month	Air Temp. C°		Relative Humidity%		Rain fall (mm)
	Max.	Min.	Max.	Min.	
March	14.2	6.2	75.2	65.7	122.2
April	25.7	15.5	72.6	67.4	32.0
May	32.3	21.3	54.8	47.5	8.0
June	38.3	27.8	47.1	40.3	0.0
July	40.5	30.9	47.6	41.9	0.0
August	40.7	29.6	51.7	45.7	0.0
September	37.2	27.7	53.7	48.9	0.0
October	29.8	21.2	67.1	57.8	18.0

TABLE II
SOME CHEMICAL AND PHYSICAL PROPERTIES OF THE STUDIED SOILS

Soil properties	Type of soil		
	Clay	Sandy	Sandy clay
EC (dS. m^{-1})	0.40	0.30	0.50
pH	8.07	8.17	8.22
Total N (%)	0.06	0.04	0.06
P^{3-} (ppm)	3.60	6.18	5.54
Zn^{2+} (mg/L)	0.19	0.18	0.20
CO_3^{2-} (mg/L)	0.00	0.00	0.00
HCO_3^- (mg/L)	2.80	2.90	2.00
Ca^{2+} (mg/L)	6.60	9.60	7.00
Mg^{2+} (meq/L)	3.20	1.80	1.40
Cl^{1-} (meq/L)	1.28	1.50	1.38
Na^+ (meq/L)	1.46	1.07	0.73
K^+ (meq/L)	0.24	0.16	0.19
SO_4^{2-} (meq/L)	7.42	8.23	5.94
Gypsum (%)	0.32	0.00	0.00
Organic Matter (%)	1.04	0.15	1.02
Clay ($g.kg^{-1}$)	638	222	322
Sand ($g.kg^{-1}$)	62	655	555
Silt ($g.kg^{-1}$)	300	123	123
Textural name	Clay soil	Sandy soil	Sandy clay soil

III. RESULTS AND DISCUSSION

A. *Effect of Time of Sowing and some Pre-treatments on D. sissoo Seeds Germination.*

Results in Table III show significant differences between different times of sowing on the rate of germination. The highest value recorded in April sowing time (19.11%), while the lowest value (0.00%) recorded in March. The highest seed germination (10.89%) recorded when both sides of the pod were cut with soaking in tap water for 24h, whereas, the lowest value (9.00%) recorded in control pods. Interaction between different times of sowing and pre- treatments had significant effect on the rate of seed germination, the highest value (32%) obtained from April sowing with cutting both sides of the pod and soaking in tap water for 24 h, while the lowest value (0.00%) obtained from seeds sowing in March with different pre-treatments sowing.

The failure of March sowing date, may due to snow falling that precipitated and accumulated in the beds followed by dissolving, that led to the decay of the seeds in their beds, also it may be due to decrease in temperature 6.2° C which caused decreasing enzymes activity (Salisbury and Ross, 1991). This study agrees with Khera and Singh (2005) that germination of seeds is strongly influenced by different environmental factors, like water stress, light requirements and temperature. Increasing temperature leads to changes in protein conformation occur which promote the germination process, and too high temperatures may weaken or decrease seed activity, also too much moisture may limit the supply of air, under normal conditions (Robbins, 2004), for the above reasons, may be the seeds sown in March died and not germinated.

TABLE III
EFFECT OF TIME OF SOWING, SOME PRE- TREATMENTS AND THEIR INTERACTIONS ON *D. sissoo* SEEDS GERMINATION RATE

Treatments	Germination rate (%)
Date of sowing	
15 March	0.00 c *
15 April	19.11 a
15 May	5.00 b
Pre-treatments	
Control or untreated pods	6.00 a
Soaking pods in tap water for 24 hours	6.44 a
Cutting one side of the pod	7.78 a
Cutting one side of the pod with soaking in tap water for 24 h	7.78 a
Cutting both sides of the pod	9.33 a
Cutting both sides of the pod with soaking in tap water for 24 h	10.89 a
Interaction	
15 March + Control or untreated pods	0.00 f
15 March + Soaking pods in tap water for 24 hours	0.00 f
15 March + Cutting one side of the pod	0.00 f
15 March + Cutting one side of the pod with soaking in tap water for 24 h	0.00 f
15 March + Cutting both sides of the pod	0.00 f
15 March + Cutting both sides of the pod with soaking in tap water for 24 h	0.00 f
15 April + Control or untreated pods	12.67 bcd
15 April + Soaking pods in tap water for 24 hours	18.00 bc
15 April + Cutting one side of the pod	13.33 bcd
15 April + Cutting one side of the pod with soaking in tap water for 24 h	21.33 b
15 April + Cutting both sides of the pod	17.33 bc
15 April + Cutting both sides of the pod with soaking in tap water for 24 h	32.00 a
15 May + Control or untreated pods	5.33 def
15 May + Soaking pods in tap water for 24 hours	1.33 ef
15 May + Cutting one side of the pod	10.00 cdef
15 May + Cutting one side of the pod with soaking in tap water for 24 h	2.00 ef
15 May + Cutting both sides of the pod	10.67 cde
15 May + Cutting both sides of the pod with soaking in tap water for 24 h	0.67 ef

* Means followed by the same letters within column are not significantly different at $p \leq 0.05$ according to the Duncan test.

Significant effect of cutting both sides of the pod with soaking in tap water for 24h on seeds germination, may due to provide the fastest movements of water into the seeds, because of those species of seeds have hard coats that are impermeable to water, however, after a sufficient time in the soil, with warmth, moisture, and action of soil organisms, the coat becomes permeable, water can enter the seed, and then germination will start (Robbins, 2004). The results agree with Sheikh and Abdul Matin (2007), Singh and Kaushik (2011), and Idrees and Mohammed (2014) were studied the soaking of *D. sissoo* seeds in water for 24 hours at room temperature or dewinging the seeds, which led to increasing seeds germination rate.

B. Effect of Different Soil Textures on Seedling Survival, Number of Seedling Leaves and Seedling Height

Table IV shows the significant increase in each of rate of survival seedling, leaves number and seedling height in sandy clay soil compared to clay soil.

TABLE IV
EFFECT OF DIFFERENT SOIL TEXTURES ON SURVIVAL AND SOME VEGETATIVE GROWTH CHARACTERISTICS OF *D. sissoo* SEEDLING.

Type of soil	Seedling survival rate (%)	Number of leaves. seedling^{-1}	Seedling height (cm)
Clay	45.33 b *	13.18 c	27.50 b
Sandy	82.67 a	16.75 b	32.97 ab
Sandy clay	82.00 a	19.70 a	41.03 a

* Means followed by the same letters within columns are not significantly different at $p \leq 0.05$ according to the Duncan test.

These effects may be attributed to the physical and chemical properties of different soils used in the study, Table II, sandy soil drain easily, so water logging is not a problem, the ions absorption is easier while some of ions adsorb on the clay soil particles, their open structure means that they quick to warm up in spring, allowing earlier sowing and planting. However sandy soils do dry out very quickly and nutrients are easily washed through the soil, while clay soils are heavy, they are slow to warm in the spring, sticky when wet and very hard when dry, clay soils hold moisture and nutrients well and remain warm (James and Michael, 2009; Mazhar, Abd El-Aziz and Habba, 2010). However, it has been observed that in well-drained soils, even a few days of water logging due to poor drainage outlet may result in shisham mortality (Webb and Hossain, 2005). The intermediate properties of sandy clay soil may due to adequate soil moisture and nutrient content and formation of more carbohydrate and also new leaves and growth in the seedling, Table IV. The results agree with Geply, et al. (2011) whom found that the best soil media for growing *Jatropha curcas* is sand compare to top soil and sawdust media. The results also agree with Vishnoi, Rajwar and Kuniyal (2010) whom observed that sandy loam to sandy soil was the most suitable soil condition for *D. sissoo* growth, while results did not agree with Mazhar, Abd El-Aziz and Habba (2010) in Egypt whom found that haat plant *Jatropha curcas* L. (Euphorbiaceae) height and number of plant leaves increased by using clay media followed by sandy clay soil as compared with sandy soil.

C. Effect of Different Soil Textures and Foliar Spraying with Zinc on D. sissoo Vegetative Growth, Leaves Chemical Constituents, and some Stomata Characteristics

Vegetative Growth

Results in Table V shows that sandy clay soil increased each of seedling height, number of seedling leaves, leaf area and main root length significantly to 66.82 cm, 25.52 leaves.seedling^{-1}, 325.82 cm^2 and 36.70 cm respectively compared to clay soil and non-significantly for seedling branch number, which increased with increasing the concentration of Zn, while each of seedling height, number of seedling leaves, leaf area and main root length had no significant response to Zn application.

The interaction between soil textures and foliar application of Zn had no significant effect on seedling height and number of leaves, while the interaction treatments affected significantly on other vegetative growth characters.

Sandy clay soil stimulating the growth of plants because of the reasons mentioned in the second experiment, the interaction between different soil textures and zinc spraying affected significantly on some vegetative growth parameters, like number of branches per seedling, leaf area, main root length, these results agree with Ayad, Reda and Abdulla (2010), whom confirm that spraying zinc increased vegetative growth of *Pelargonium graveolens* L. The results also agree with Al-Imam and Al-Jubury (2008) and Al-Aareji and Al-Hamadany (2009) and Khalifa, Shaaban and Rawia (2011). This increment of growth may due to formation of the amino acid tryptophan, which consists of hormone indole acetic acid that regulates cellular elongation, apical dominance and root initiation (Obaid and Al-Hadethi, 2013).

Chemical Constituents of Leaves

Results in Table VI shows that each of soil texture and concentration of Zn weren`t affect significantly on chemical constituents of leaves except total carbohydrate which was affected by Zn spraying, while the interaction between them affected significantly only on each of shoot dry matter and total carbohydrates, the highest values were recorded from sandy clay soil with spraying 57 ppm Zn with rate 46% and 0.15% respectively, while lowest value (38.87%) for shoot dry matter was obtained from clay soil with spraying 57 ppm Zn and 0.1% carbohydrate was obtained from clay soil with spraying 114 ppm.

These effects of Zn due to zinc are closely involved in the metabolism leads to stimulation of carbohydrates, protein and the DNA formation. Several enzymes are often activated by Zn, which therefore have a considerable effect on protein synthesis and nitrogen metabolism of plants (Dickinson, et al, 2003).

Results in Table VI shows that different soil texture, foliar spraying with zinc and their interactions had non-significant effects on leaf content of chlorophyll a, b and total chlorophyll.

Results in Table VII shows that soil texture had non-significant effects on leaf content of total nitrogen, phosphorus and sulphate. Clay soil increased total potassium to 1.04%, while it decreased total zinc in leaves to 73.84 ppm compared to sandy clay soil which increase it to 91.93 ppm. Foliar spraying of Zn increased significantly the leaves content of

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total phosphorus, zinc and sulphate, and decreased potassium content, while this effect was non-significant on nitrogen content, Table VII.

Zinc foliar application on the leaves had significant effect on increasing phosphorus, potassium, sulphar and zinc concentration in leaves, these results agree with those obtained by Al-Imam and Al-Jubury (2008) and Al-Aareji and Al-Hamadany (2009). These results also agree with Ayad, Reda and Abdulla, (2010), whom confirms that spraying zinc increased total carbohydrate, nitrogen, phosphorus, potassium, total sulphate and total zinc in sandy clay and sandy soils with increasing zinc concentration.

TABLE V
EFFECT OF DIFFERENT SOIL TEXTURES, FOLIAR SPRAYING WITH ZINC AND THEIR INTERACTIONS ON SOME VEGETATIVE GROWTH OF *D. sissoo* SEEDLINGS

Treatments	Seedling height (cm)	No. of leaves. seedling^{-1}	No. of branches. seedling^{-1}	Leaf area (cm^2). seedling^{-1}	Seedling main root length (cm)
Type of soil					
Clay	49.52 b*	19.16 b	4.67 a	203.38 b	26.33 b
Sandy	56.82 ab	22.51 ab	5.44 a	342.87 a	31.72 ab
Sandy clay	66.82 a	25.52 a	5.44 a	325.82 a	36.70 a
Zinc					
Control	55.59 a	22.00 a	4.00 b	269.77 a	31.83 a
57 ppm	57.77 a	21.87 a	4.56 b	280.23 a	30.35 a
114 ppm	59.81 a	23.32 a	7.00 a	322.06 a	32.57 a
Interaction					
Clay + control	47.83 a	18.33 a	3.00 b	186.68 bc	20.94 b
Clay + 57 ppm	47.50 a	18.50 a	3.33 b	160.18 c	27.44 ab
Clay + 114 ppm	53.23 a	20.65 a	7.67 a	263.27 abc	30.61 ab
Sandy + control	50.16 a	21.20 a	3.67 b	271.94 abc	31.67 ab
Sandy + 57 ppm	59.52 a	22.81 a	5.33 ab	394.36 a	28.72 ab
Sandy+ 114 ppm	60.79 a	23.52 a	7.33 a	362.30 ab	34.78 ab
Sandy clay + control	68.78 a	26.47 a	5.33 ab	350.69 abc	42.89 a
Sandy clay+ 57 ppm	66.28 a	24.29 a	5.00 ab	286.14 abc	34.89 ab
Sandy clay+ 114 ppm	65.40 a	25.80 a	6.00 ab	340.62 abc	32.33 ab

* Means followed by the same letters within columns are not significantly different at $p \le 0.05$ according to the Duncan test.

TABLE VI
EFFECT OF DIFFERENT SOIL TEXTURES, FOLIAR SPRAYING WITH ZINC AND THEIR INTERACTIONS ON CHEMICAL CONSTITUENTS OF *D. sissoo* LEAVES

Treatments	Shoot dry Matter (%)	Root dry Matter (%)	Total Carbohydrate (%)	Chlorophyll a	Chlorophyll b	Total Chlorophyll
				mg /100g wet weight		
Type of soil						
Clay	41.82 a	46.85 a	0.12 a*	1.93 a	1.56 a	3.49 a
Sandy	39.77 a	45.07 a	0.12 a	1.99 a	1.51 a	3.49 a
Sandy clay	42.87 a	46.57 a	0.14 a	2.08 a	1.96 a	4.04 a
Zinc						
Control	40.90 a	45.40 a	0.13 ab	1.92 a	1.64 a	3.56 a
57 ppm	41.61 a	46.68 a	0.14 a	2.12 a	1.67 a	3.79 a
114 ppm	41.95 a	46.02 a	0.11 b	1.95 a	1.72 a	3.67 a
Interaction						
Clay + control	41.16 ab	45.76 a	0.12 ab	1.77 a	1.57 a	3.33 a
Clay + 57 ppm	38.87 b	45.90 a	0.14 ab	2.15 a	1.62 a	3.77 a
Clay + 114 ppm	45.44 ab	48.89 a	0.10 b	1.86 a	1.50 a	3.36 a
Sandy + control	39.99 ab	45.15 a	0.12 ab	1.83 a	1.52 a	3.36 a
Sandy + 57 ppm	39.97 ab	46.58 a	0.13 ab	2.26 a	1.26 a	3.51 a
Sandy+ 114 ppm	39.36 ab	43.48 a	0.10 b	1.87 a	1.74 a	3.61 a
Sandy clay + control	41.56 ab	48.34 a	0.14 ab	2.16 a	1.84 a	4.00 a
Sandy clay+ 57 ppm	46.00 a	47.57 a	0.15 a	1.96 a	2.12 a	4.08 a
Sandy clay+ 114 ppm	41.05 ab	48.35 a	0.12 ab	2.12 a	1.91 a	4.03 a

* Means followed by the same letters within columns are not significantly different at $p \le 0.05$ according to the Duncan test.

TABLE VII
EFFECT OF DIFFERENT SOIL TEXTURES, FOLIAR SPRAYING WITH ZINC AND THEIR INTERACTIONS ON SOME CHEMICAL CHARACTERISTICS OF *D. sissoo* LEAVES

Treatments	Total Nitrogen%	Total Phosphorus%	Total Potassium%	Total Zinc (ppm)	Total Sulphate%
Type of soil					
Clay	2.04 a*	0.38 a	1.04 a	73.84 b	0.19 a
Sandy	2.56 a	0.40 a	0.87 b	78.03 ab	0.22 a
Sandy clay	2.52 a	0.36 a	0.90 b	91.93 a	0.24 a
Zinc					
Control	2.17 a	0.31 b	0.98 a	68.48 b	0.19 b
57 ppm	2.43 a	0.41 a	0.94 ab	75.63 b	0.23 ab
114 ppm	2.52 a	0.42 a	0.90 b	99.70 a	0.24 a
Interaction					
Clay + control	1.15 b	0.33 b	1.11 a	55.73 d	0.17 b
Clay + 57 ppm	2.75 a	0.42 ab	1.10 a	70.60 bc	0.16 b
Clay + 114 ppm	2.22 ab	0.38 ab	0.91 b	95.20 ab	0.26 a
Sandy + control	2.73 a	0.32 b	0.92 b	61.90 cd	0.18 ab
Sandy + 57 ppm	2.19 ab	0.40 ab	0.84 b	78.80 bc	0.26 a
Sandy+ 114 ppm	2.75 a	0.48 a	0.86 b	93.40 ab	0.22ab
Sandy clay + control	2.63 a	0.29 b	0.90 b	87.80 ab	0.21 ab
Sandy clay+ 57 ppm	2.33 a	0.40 ab	0.87 b	77.50 bc	0.27 a
Sandy clay+ 114 ppm	2.59 a	0.39 ab	0.93 b	110.50 a	0.23 ab

* Means followed by the same letters within columns are not significantly different at $p \leq 0.05$ according to the Duncan test.

Effect on Some Stomata Characteristics

Stomata structure in *D. sissoo* seedlings leaves is shown in Fig. 1 and Fig. 2, both adaxial and abaxial epidermis have stomata. The anatomical study indicated to non-significant differences between soil textures, zinc application and their interaction on adaxial and abaxial stomata number, width and adaxial stomata length, Table VIII, whereas, the interaction between soil texture and foliar spraying with zinc increased stomata length significantly in abaxial surface of seedlings that growing in clay soil and sprayed with 57 ppm zinc compared to seedlings growing in sandy soil and sprayed with 57 ppm zinc.

These results agree with Artik (2005) who refers that stomata number on lower surface is more than stomata number on upper surface in *Vicia faba* L. plants. These results also agree with other studies that mentioned that stomata characteristics like number, length and width is affected by genetic constituents, ecological condition, environmental factors, physiological process, season, leaf position and leaf surface (Caglar, Sutyemez and Sudhakar, 2004; Peksen, Peksin and Artik, 2006).

TABLE VIII
EFFECT OF DIFFERENT SOIL TEXTURES, FOLIAR SPRAYING WITH ZINC AND THEIR INTERACTIONS ON SOME STOMATA CHARACTERISTICS ON UPPER & LOWER LEAVE SURFACES OF *D. sissoo*

Treatments	Stomata Number /mm^2		Stomata length (μm)		Stomata width (μm)	
	Adaxial surface	Abaxial surface	Adaxial surface	Abaxial surface	Adaxial surface	Abaxial Surface
Type of soil						
Clay	77.56 a*	177.78 a	22.17 a	14.39 a	19.11 a	13.44 a
Sandy	81.56 a	202.22 a	22.33 a	13.83 a	19.06 a	13.28 a
Sandy clay	73.78 a	193.11 a	22.11 a	14.39 a	19.06 a	13.28 a
Zinc						
Control	83.78 a	190.22 a	22.39 a	14.06 a	18.44 a	12.83 a
57 ppm	75.33 a	185.56 a	22.67 a	14.44 a	19.94 a	13.50 a
114 ppm	73.78 a	197.33 a	21.56 a	14.11 a	18.83 a	13.67 a
Interaction						
Clay + control	78.67 a	174.00 a	22.33 a	13.83 ab	18.50 a	12.83 a
Clay + 57 ppm	76.00 a	168.00 a	23.67 a	15.50 a	20.50 a	13.67 a
Clay + 114 ppm	78.00 a	191.33 a	20.50 a	13.83 ab	18.33 a	13.83 a
Sandy + control	85.33 a	197.33 a	22.17 a	13.83 ab	18.00 a	13.00 a
Sandy + 57 ppm	80.00 a	206.00 a	22.33 a	13.67 b	19.33 a	13.00 a
Sandy+ 114 ppm	79.33 a	203.33 a	22.50 a	14.00 ab	19.83 a	13.83 a
Sandy clay + control	87.33 a	199.33 a	22.67 a	14.50 ab	18.83 a	12.67 a
Sandy clay+ 57 ppm	70.00 a	182.67 a	22.00 a	14.17 ab	20.00 a	13.83 a
Sandy clay+ 114 ppm	64.00 a	197.33 a	21.67 a	14.50 ab	18.33 a	13.33 a

* Means followed by the same letters within columns are not significantly different at $p \leq 0.05$ according to the Duncan test.

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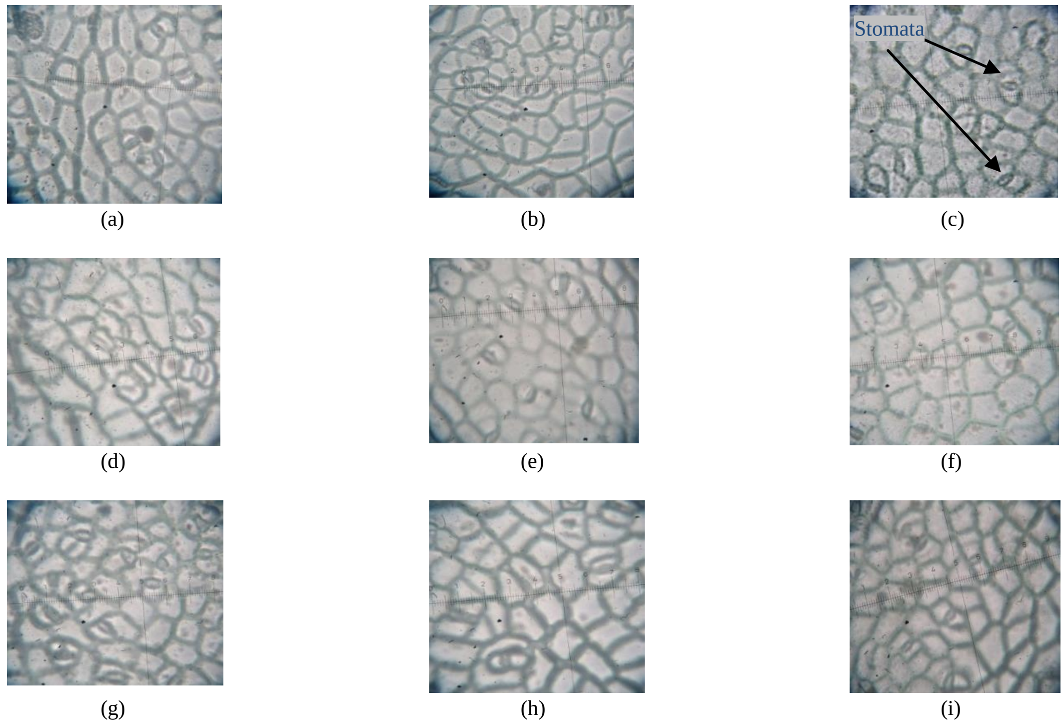

Fig. 1. Upper (adaxial) *D. sissoo* leaves surfaces stomata 400X for seedlings grown in; (a) Clay soil and no Zinc sprayed, (b) Clay soil and sprayed with 57 ppm Zinc, (c) Clay soil and sprayed with 114 ppm Zinc, (d) Sandy soil and no Zinc sprayed, (e) Sandy soil and sprayed with 57 ppm Zinc, (f) Sandy soil and sprayed with 114 ppm Zinc, (g) Sandy clay soil and no Zinc sprayed, (h) Sandy clay soil and sprayed with 57 ppm Zinc and (i) Sandy clay soil and sprayed with 114 ppm Zinc.

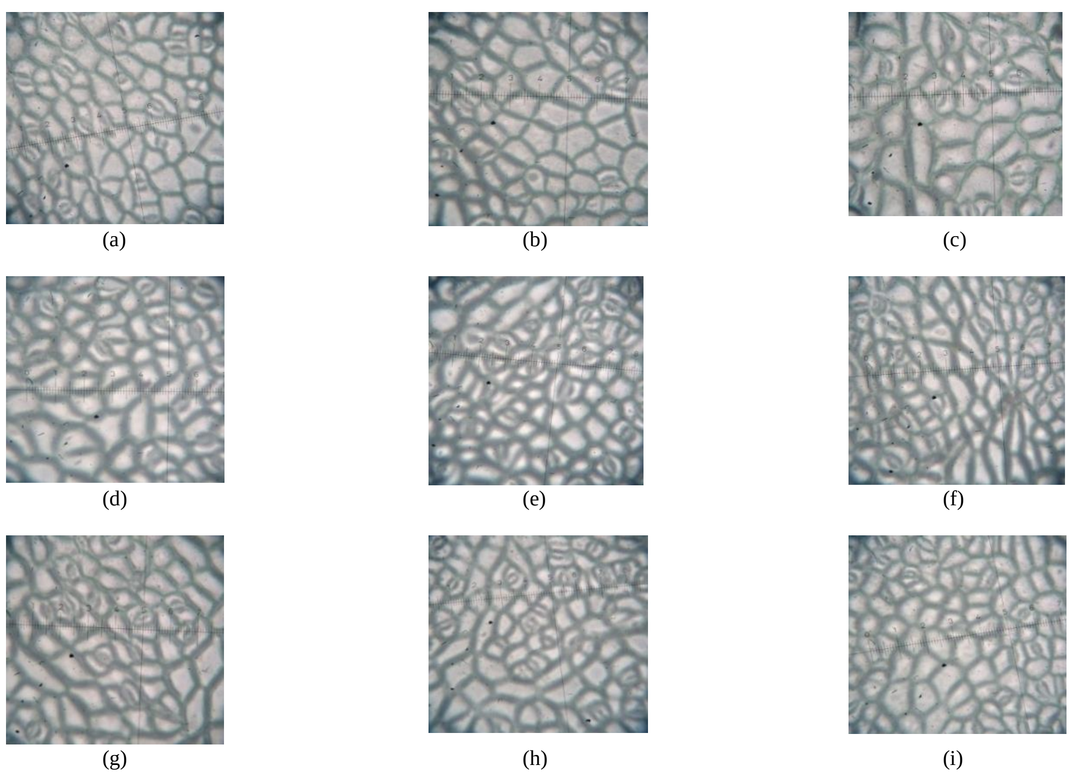

Fig. 2. Lower (abaxial) *D. sissoo* leaves surfaces stomata 400X for seedlings grown in; (a) Clay soil and no Zinc sprayed (b) Clay soil and sprayed with 57 ppm Zinc, (c) Clay soil and sprayed with 114 ppm Zinc, (d) Sandy soil and no Zinc sprayed, (e) Sandy soil and sprayed with 57 ppm Zinc (f) Sandy soil and sprayed with 114 ppm Zinc, (g) Sandy clay soil and no Zinc sprayed, (h) Sandy clay soil and sprayed with 57 ppm Zinc and (i) Sandy clay soil and sprayed with 114 ppm Zinc.

IV. Conclusions

From this research it was evident that different date of sowing and different seed pre-treatment have significant effects on germination rate of *Dalbergia sissoo* (Roxb.) in Koya city. Best time was 15th April, while best pre-treatment for seeds was cutting both sides of seeds. Data analysis also shows that growth of seedling is strongly depend on soil texture, sandy clay soil was the best media for growing the seedling. Foliar spraying of Zinc has a good role in improving most of the vegetative growth characteristics and chemical constituents of leaves except potassium.

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