EFFECT OF FERTILIZATION ON THE GROWTH AND FOLIAR MINERAL COMPOSITION OF WALNUT (*JUGLANS REGIA* LINN.)

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Abstract:

Fertilization with NPK alone and in combination on 8 and 20 year old walnut (*Juglans regia*) plantations in Kaghan and Azad Kashmir revealed significant difference in height and diameter growth in the younger crop. Also the foliar mineral composition of the young stands had significantly increased, while there was no such indication for the older plants. Higher dose of the fertilizers is recommended for future trials.

Introduction:

Walnut (*J. regia*) yields an excellent timber which is in great demand for quality furniture, cabinet work, pannelling, veneering and a variety of other special woodworks. The tree is widely distributed in the Himalayan moist temperate forests (Champion et. al. 1965)[2] of Pakistan and is also being raised in the form of plantations in Kaghan and Kashmir valleys. The growth of such plantations is not upto the mark and trees exhibit leaf chlorosis, deformity and retarted growth. The reasons for such disturbed vegetative growth could be poor nutrient availability.

In order to boost up growth rate, NPK fertilizer studies were initiated in 1979 on 8 and 20 year old planted crops in Kaghan and Azad Kashmir respectively during 1979.

Materials and Methods:

Site No 1: 8–year old plantations of walnut was taken at Malakandi in Shogran Range of Kaghan Forest Division in Hazara, N.W.F.P., 8 NPK fertilizer treatments (i.e. control, N,P,K, NP, NK, PK and NPK) were given in 7 replications in "Factorial Design" taking 8 contiguous plants per treatment. Fertilizers were added to each tree on 31.7.1979 at the following rates:

1. Urea 46% N = 500 gms;
2. Single superphosphate 20% P_2O_5 = 1000 gms;
3. Potassium sulphate 20% K_2O = 500 gms.

Site No 2: 20 year old walnut crop was slected at Dingian, Azad Kashmir valley. 8 fertilizer treatments (i.e. C, N, P, K, NP, NK, PK and NPK) were applied on 31.5.1979 in 5 replications in "Factorial Design" taking single tree for a treatment. Commercial fertilizers were added in the following doses per tree.

Urea, 46%N = 250 gms;

Single superphosphate, 20%P_2O_5 = 1000 gms;

Potassium sulphate, 20% K_2O = 500 gms.

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At both the experimental sites, fertilizer doses were given in a radius of one metre around the tree and worked thoroughly with soils. Each tree was marked for reference and the undesirable side branches pruned off to breast height. The height and diameter growth of each tree was recorded at the time of fertilization.

Collection of Soil Samples:

Soil samples were collected before fertilization at a depth of 0–30, 30–60 and 60–90 cm making one pit in each replication. Samples collected from a similar depths of each pit were mixed and made as one "composite sample". In total 3 samples were obtained. These were packed in double polythene bags, labelled with reference number and brought to soil laboratory. These were ground and passed through 2 mm sieve and analysed for physico-chemical parameters as shown in table 1 and 2 using the standard methods as outlined by Chapman and Pratt (1961)[1]; Lambert (1976)[5]; and Khan and Rafiq (1980)[4].

Collection of Foliage Samples:

In August 1980 foliage samples of the newly developed apical tissues from the upper, middle and basal branches from one random tree per replication were collected and made into a "composite sample". Samples were packed in double paper bags, labelled with identification number and brought to soil laboratory. These were dried in oven at 75°C for 24 hours and ground in a crushing electric mortar. Samples were analysed for N, P and K contents after drying in oven at 105°C as shown in table 3 and 4 using the standard methods as described by Chapman and Pratt (1961)[1] and Lambert (1976)[5].

Results and Discussions:

Physico-chemical Characteristics of the Experimental Areas: Evaluating the site qualities of the two different study areas, data presented in Table 1 and 2 show that the site of Malakandi though is poor in texture but comparatively contains more clay (9.8–15.0%) and less sand particles (60.2%). It is acidic in nature (pH 6.1 – 6.5) and contains 6–12% calcium carbonate. The total organic matter is 8% at the top layer and decreases to 5% in the lower horizons. Likewise, the total nitrogen contents ranged from 0.345% at the top layer to 0.229% at the lower depths. Similarly total phosphorus and potassium contents ranged from 23–15 ppm and 190–138 ppm respectively. These values are safe values for normal soils and plant growth, except for potassium. In addition to this, the fixation of essential plant nutrients under high calcium carbonate contents and in the presence of adequate amount of organic matter, their release to plants in available form under favourable environmental conditions is quite possible in this type of soil.

In contrast to Kaghan experimental site, data presented in Table 2 indicates that the site at Dingian, Azad Kashmir is poor in texture. It contains approximately 6.8% clay and has a dominant group of sand particles (68.2 – 76.2%). It is acidic (pH 5.8 – 6.2); the total organic matter contents being medium in the top Layer (4.0%) decreasing gradually with depth (1.5%). Whereas the total nitrogen contents is low (0.184 – 0.046%) throughout the profile. The total phosphorus content is medium (19–13 ppm) and the total potassium content is low (150–115 ppm) respectively. The physico-chemical characteristics of the site show that such type of soil

Table No. 1

PHYSIO-CHEMICAL CHARACTERISTICS OF MALAKANDI – SHOGRAN – KAGHAN EXPT.
SITE WHERE 8 YEAR OLD WALNUT CROP WAS PLANTED

Sl. No.	Depth cm	Physical Parameters				Chemical Parameters							
		Sand %	Silt %	Clay %	Text. class (ISSS)	pH (Sat. Paste	$CaCo_3$ equiva lent %	$E^{C}_{e}x10^{3}$ 0	TSS %	0.M %	N %	P PPm	K PPm
1.	0–30	60.2	30.0	9.8	Sandy Loam	6.1	6.0	0.6	0.038	8.0	0 345	23	190
2.	30–60	60.0	30.0	10.0	–do–	6.3	10.0	0.4	0.026	6.0	0.276	15	138
3.	60–90*	60.0	25.0	15.0	–do–	6.5	12.0	0.4	0.026	5.0	0.229	15	138

Table No. 2

PHYSCIO-CHEMICAL CHARACTERISTICS OF DINGIAN – AZAD KASHMIR EXPT.
SITE WHERE 20 YEAR OLD WALNUT CROP WAS PLANTED

Sl. No.	Depth cm	Physical Parameters				Chemical Parameters							
		Sand %	Silt %	Clay %	Text. class (ISSS)	pH (Sat. Paste	$CaCo_3$ equiva lent %	$E^{C}_{e}x10^{3}$ 0	TSS %	0.M %	N %	P PPm	K PPm
1.	0–30	68.2	25.0	6.8	Sandy Loam	5.8	NIL	0.5	0.032	4.0	0.184	19	150
2.	30–60	74.2	19.0	6.8	–o––	6.0	NIL	0.3	0.019	1.9	0.069	13	115
3.	60–90*	76.2	17.0	6.8	–do–	6.2	NIL	0.3	0.019	1.5	0.046	13	115

*Parent material beyond 90 cm depth.

is not only deficient in essential plant nutrients, but also poor to adsorb, retain and supply the plant nutrients in available form adequately during the growth period, until and unless these are supplied with readily available plant nutrients in the form of fertilizers.

Effect of site quality and fertilization on growth rate and foliar mineral composition:

Forest trees are perennial crop, and can retranslocate nutrients from senescing tissues that are several seasons old to regions of active growth. Nutrients like N, P and and K are relatively mobile in phloem, and much of the annual demand by phloem for these nutrients is met internally through retranslocation or addition of readily soluble and available nutrient fertilizers.

In this study, F-test indicates that the application of fertilizers together with favourable physico-chemical properties of the site in Kaghan (Table 1) had significantly increased (at 1% level) the height and diameter growth, and also the foliar nutrient contents (Table 3). This could be attributed partly to the productiveness of the site and partly to the fertilization effect. Also the crop was younger and seems to have responded to fertilization more favourably.

Table No. 3.

EFFECT OF NPK FERTILIZERS ON THE GROWTH RATE AND FOLIAR MINERAL COMPOSITION OF 8 YEARS OLD *J. REGIA* CROP PLANTED IN MALAKANDI – SHOGRAN OF KAGHAN VALLEY

Fert. treatments	Growth rate		Mineral composition		
	Avg. Height m	Values Dia. cm	Avg. N %	P ppm	Values K ppm
Control	5.6	6.1	1.7	1700	12000
N	5.6	6.1	2.3	1750	12030
P	6.3	6.6	2.3	1750	12030
K	6.9	7.7	2.0	1710	12040
NP	6.8	7.1	2.6	1790	12040
NK	6.7	6.5	2.3	1720	12050
PK	6.6	6.9	2.3	1720	12050
NPK	6.0	6.7	2.7	1800	13000

Table No. 4.

EFFECT OF NPK FERTILIZERS ON THE GROWTH RATE AND FOLIAR MINERAL COMPOSITION OF 20 YEARS OLD *J. REGIA* CROP PLANTED IN DINGIAN – AZAD KASHMIR VALLEY

Fert-treatments	Growth rate		Mineral composition		
	Avg. Height m	Values Dia cm	Avg. N %	Avg. P ppm	Values K ppm
Control	4.4	8.5	1.0	1600	11800
N	4.1	8.6	1.1	1610	11800
P	4.0	8.2	1.1	1610	11800
K	4.1	8.9	1.0	1600	11800
NP	4.8	9.2	1.2	1620	11800
NK	3.9	7.2	1.0	1600	11800
PK	4.1	8.3	1.0	1600	11800
NPK	4.2	8.5	1.2	1620	11800

In contrast to this, fertilization did not affect the height, diameter growth and the foliar mineral composition of 20 year old walnut crop planted at Dingian, Azad Kashmir (Table 4). This could be ascribed to poor productivity/fertility of the site.(Table 2) and that the amount of fertilizers added were inadequate to fulfill the demand of the older stand under such infertilie conditions.

Studying the effect of macro-nutrients and boron in three different varieties of Mulberry, Fonseca et. al (1973)[3] noted some valuable critical foliar nutrient range for N, P and K contents for broad leaved trees. It was 1.85 – 3.70% for N; 500–3000 ppm for P; and 12000–32000 ppm for K contents. The lower values are the deficient range whereas the higher values are in the sufficiency zone. However values of N, P and K contents presented in Table 3 and 4 in this study generally fall in deficient range for a good stand as far as nutrient status in broad leaved trees is concerned.

Conclusion:

Apart from distinctive physico-chemical conditions available at the two sites and their

reaction to different fertilizer combinations, it can safely be construed that the doses of NPK were light and better response could be expected with a higher dose.

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