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EFFECT OF PHOSPHORUS NUTRITION ON THE GROWTH OF *SESAMUM INDICUM* L.

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The economically important oil crop *Sesamum indicum* L. was cultured with Hoagland nutrient solution with different concentration of phosphorus and without phosphorus. The effect of different levels of phosphorus on growth parameters was observed in shoots and roots on 10, 12 and 14th day. The growth of the seedlings responded positively and significantly when the phosphorus concentration was increased. The maximum growth rate was observed in the seedlings treated with 310 mg/1 of phosphorus whereas in phosphorus free seedlings the root was affected severely than shoot. The buffer soluble protein and phosphorus content of seedlings have positive correlation with increasing concentrations of phosphorus. The difference in phosphorus content and buffer soluble protein content of shoots was small between phosphorus free and supplied seedlings whereas in root it was large.

Keywords : Growth character studies; Phosphorus; Sesame.

Introduction

Plant nutrition is of unique importance in the realm of life on earth and in the affairs of man[1]. Mineral nutrients are essential to plants for their growth and development. The exclusive requirements of higher plants for inorganic nutrients basically distinguishes these organisms from man, animals and a number of microorganisms which additionally need organic nutrients[2]. Among the essential elements, phosphorus plays an inevitable role in heredity, structure of membrane, enzymatic reation and structural component of intermediary metabolites[3]. The phosphorus is present in the from of phytate in seeds of moot higher plants, 50% in legume seeds, 60-70 % in cereal grains, and 15-30 % in potato tubers[4]. It is usually present in the plant as calcium or magnesium salts known as phytin.

Among the oil seeds, *Sesamum* seeds is rich source of protein, carbohydrates and mineral nutrients, such as calcium and phosphorus[5]. Therefore the present investigation was directed to, increasing our understanding of growth rate of the seedlings of *Sesamum* in response to changes in phosphorus availability.

Materials and Methods

Seeds of *Sesamum indicum* L. (cv. TMV3) were surface sterilized with 0.1% mercuric chloride, and the seeds were soaked in glass distilled water for 2 hours. Plastic tray of 3 lit. capacity with plastic mashed disc filled with vermiculite was used for seeding growth. Hoagland[6] nutrient solution containing 31 mg phosphorus (P) /1 (designated as P 31) served as the control. 155 mg/1 (designated as P 155) and 310 mg/1 (designated as P 310), were the two experimental concentration used. To make phosphorus free Hoagland nutrient solution, ammonium carbonate was used instead of ammonium dihydrogen orthophosphate. Seedlings grown under phosphorus deficiency is designated as phosphorus free seedling or P 0. For seven days all the seedling were grown under control (P 31) condition. Afterwards three sets of seedlings were subjected to P 0, P 155 and P 310 treatments. Fresh nutrient solutions were replaced on every alternate day. All experiments were carried out in triplicate and repeated twice. Length of the shoot and root length were measured from 7 to 14th day. 10, 12 and 14th days old seedlings were analyzed for biomass, phosphorus[7] and buffer soluble protein content[8].

Results and Discussion

Crop behave differentially with respect to pattern of phosphate removal and respond to applied phosphate and to the present in soil. The level of phosphorus in the nutrient medium has a direct bearing on the growth of the plant. Higher the phosphorus in the medium is increased the length of shoot (Table1). To facilitate the comparison, the length of shoot and root on diffenrent day is expressed as percentage of 14th day value (P 310). In the case of shoot, the difference between the 7th and 14th day value is 27.2% for P O, 44% for P 31, 45.6% for P 155 and 50.4% for P 310 seedlings. The root length also related to level of the phosphorus, but the rate of the growth is varied. On the 14th day the root length increment over the initial value is 100% and 117% in P O and P 310 seeling respectively (Table 1) where as it is 86% and 94.6 % in P 31 and P 155 seedlings. This is reflected in shoot-root ratio (Table 2). Due to a drastic reduction in the root length, the shoot:root ratio is higher in P O seedling. In P 31 and P 155 seedling the ratio remains same over the days whereas in P 310 seedling the shoot:root ratio registered a decline in the later days which may be a sing of maturity. Growth of *Casurina equisetifolia* responded more to increased P availability, when it was largely dependent on N_2 fixation then when fertilized with N is low P soils[9]. Growth of *Glicridia sepium* and *Senna spectabilis* responded to P application of 40 kg/ha for the two species respectively[10].

Phosphorus deficiency reduce the root length than shoot length in Barley plants[11]. Thus phosphorus deficiency caused stunted growth in sesame. This is understandable as phosphorus is essential for the very formation of roots[12] and in cases as the present one may act as limiting element. Phosphorus supply increase the growth and yield of *Hordeum vulgare* L.[13] and in *Lolium* sp[14].

Not only in terms of length, but also on the basis of dry matter the effect of Phosphorus deficiency is more severe in roots than shoots. When the fresh and dry weight (Figure 1-4) are scrutinized, it is evident that the difference in weight between the P 0 and P 310 shoots is more in early days, but gradually decreases with aging. This variation in the data is due to the presence of excess moisture in the P0 roots. Thus the moisture masks the decline in drymatter of P 0 roots (Table 3). Phosphorus deficiency is known to decrease the drymatter of peanut plants[12]. Phosphorus alone or in combination with N, K has increased the drymatter in groundnut plants[15]. The dry matter yield and total P uptake in sunflower was increased with increasing concentration of P[16]. P at the rate of 40 kgP_2O_5/ha was superior to other treatments in terms of juice yield and quality characters of sweet *Sorghum*[17]. Application of fertilizers, particularly N, and P to pea affects its yield substantially, N requirement of the high yielding varieties in fairly high and P is known to enhance the activity of Rhizobia and thus atmospheric nitrogen fixation[10]. P produced significant effect on pod yield of pea plants[18]. The yield seed weight and cooking quality of field pea plants was increased with increasing

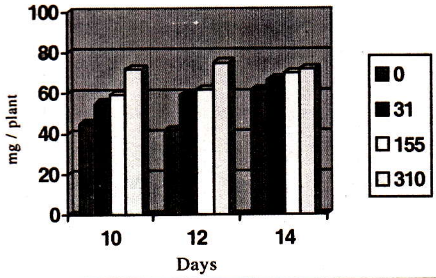


Fig : 1
Effect of phosphorus on fresh weight of shoot of sesame

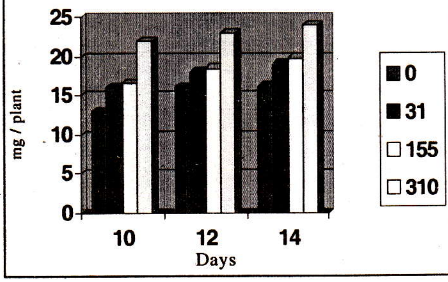


Fig : 2
Effect of phosphorus on fresh weight of the root of sesame

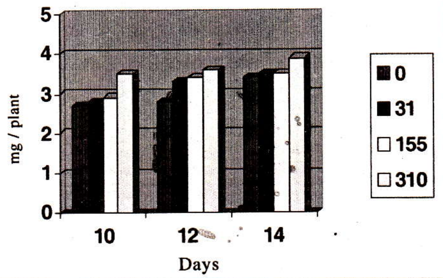


Fig : 3
Effect of phosphorus on dry weight of the shoot of sesame

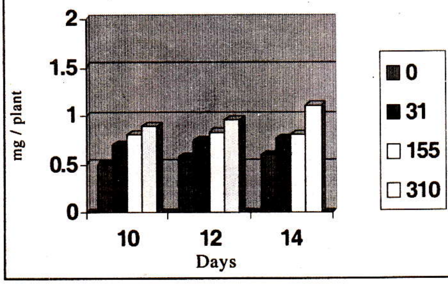


Fig : 4
Effect of phosphorus on dry weight of the root of sesame

concentration of P[19]. Pea plants require large amount of P for the development of better size pods with bold grains and ultimately more yield[18].

The highest phosphorus content was observed in both shoots and roots of P 310 plants at 14th day, followed by seedlings supplied with P 155, P 31 and P 0 plants (Fig. 5, 6). The difference in the level of phosphorus content between phosphorus free and phosphorus supplied seedlings is distinct and sharp especially in the root but not so dramatically in the shoot. Similar results was reported in N_2 fixing and non-N_2 fixing leguminous trees[10]. The shoot : root ratio of phosphorus content (Table 4) further substantiates our observations. The distribution of P between shoots and roots was not simply caused by the ratio of dry matter from shoots and roots and the linear relationship between the plant weight and Paccumulated. In such types, P translocation and P use efficiency influence dry matter production especially in *Senna siamea*[10]. Our observations in the present experiments are in conformity with other studies, where an increase in phosphorus content in phosphorus supplemented plants have been reported in groundnut[20], in *Cenhrus setigerus*[21], in wheat[22] and leaf discs of Tomato[23-25].

The level of buffer soluble protein also increased with increasing of phosphorus and increasing age of the seedlings. Among the four concentrations, the 310 mg/1 treated seedling have higher amount of protein than other seedlings (Fig. 7,8). Decreased protein synthesis in phosphorus deficient pea plants has been reported earlier[26]. Plants grown in phosphorus deficient medium have low level of the mineral in stem, leaf and shoots, the phosphorus may come from the initial store in the seeds[27].

Fig : 5
Effect of phosphorus on phosphorus content of shoot of Sesame

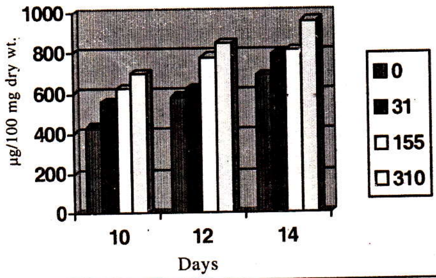


Fig : 6
Effect of phosphorus on phosphorus content of root of Sesame

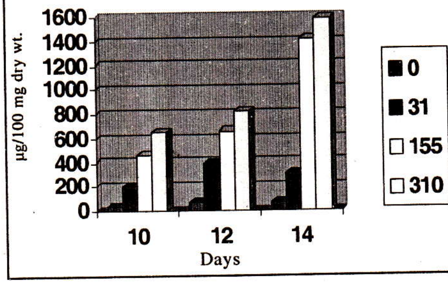


Fig : 7
Effect of phosphorus on Buffer soluble proteins of shoot of sesame

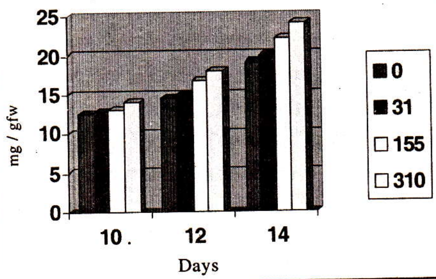
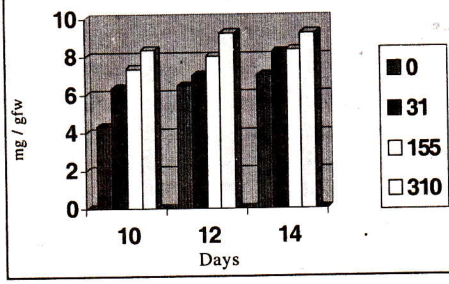


Fig : 8
Effect of phosphorus on Buffer soluble proteins of root of sesame



Mineral fertilization increase the content of crude protein[28]. The protein content is increased due to increased availability of phosphorus[29]. The increase in protein content due to phosphorus is reported in groundnut[30] and in *Zea mays*[31].

In conclusion, the growth, the buffer soluble protein and phosphorus contnet of seedlings reponded positively and significantly when the phosphorus concentration is increased. The phosphorus enhance the growth characters, further addition of maximum recommended levels of P in soils might boost the yield characters especially oil content of the *Sesamum indicum* L.

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Table 1. Shoot (S) and root(R) length (mm) of *Sesamum indicum* L. as influenced by different levels of Phosphorus.

Days	phosphorus in the nutrient medium (mg/1)							
	0		31		155		310	
	S	R	S	R	S	R	S	R
07	55 ±1.23	22 ±1.63	60 ±1.87	40 ±1.47	65 ±2.21	42 ±1.23	68 ±1.63	48 ±1.63
08	60 ±1.13	25 ±3.26	70 ±2.86	48 ±3.36	72 ±0.94	50 ±1.63	75 ±1.63	53 ±2.11
09	70 ±4.08	27 ±2.75	81 ±2.45	54 ±1.63	83 ±2.11	55 ±4.12	86 ±0.40	60 ±3.67
10	75 ±3.26	30 ±3.11	86 ±1.63	56 ±1.63	95 ±4.12	59 ±0.82	99 ±3.47	71 ±1.63
11	79 ±1.72	34 ±1.11	90 ±0.61	57 ±0.41	100 ±4.12	63 ±0.57	105 ±3.67	80 ±3.34
12	80 ±4.12	35 ±1.48	100 ±4.12	59 ±2.11	105 ±1.63	67 ±2.45	110 ±4.12	84 ±1.22
13	83 ±2.62	39 ±2.62	105 ±4.12	60 ±2.77	108 ±1.63	70 ±1.63	118 ±1.63	90 ±2.12
14	86 ±3.35	42 ±2.11	110 ±4.12	65 ±1.87	117 ±2.45	74 ±1.63	125 ±2.77	95 ±1.63

Table 2. Shoot/Root ratio of *Sesamum indicum* L.

Days	phosphorus in the nutrient medium (mg/1)			
	0	31	155	310
07	2.50	1.50	1.54	1.41
08	2.40	1.45	1.44	1.41
09	2.59	1.50	1.50	1.43
10	2.50	1.53	1.61	1.39
11	2.32	1.57	1.58	1.31
12	2.38	1.69	1.56	1.30
13	2.12	1.75	1.54	1.31
14	2.04	1.69	1.58	1.31

Table 3. Moisture Content (%) of Shoot (S) and Root (R) of *Sesamum indicum* L.

Days	phosphorus in the nutrient medium (mg/1)							
	0		31		155		310	
	S	R	S	R	S	R	S	R
10	94.0	96.2	94.6	96.6	94.8	96.4	94.8	96.0
12	94.0	96.6	94.5	96.3	94.6	95.9	95.1	96.4
14	95.1	96.9	95.1	96.3	95.1	95.6	94.6	94.6

Table 4. Shoot : Root ratio of phosphorus content.

Days	phosphorus in the nutrient medium (mg/1)			
	0	31	155	310
10	1.51	0.55	0.31	0.29
12	1.92	0.36	0.26	0.26
14	0.98	0.33	0.15	0.14

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