

G R O W T H P E R F O R M A N C E
U N D E R
N A T U R A L H A B I T A T S

G. pratense: The maximum vegetative growth was recorded at S4, the plants measuring upto 45.3 ± 3.5 cms. The plant height taken as a relative measure of the extent of vegetative growth at various study sites ranged from 20.7 ± 4.5 cms. at S3 to 45.3 ± 3.5 cms. at S4. At S1 the plant height recorded was 31.7 ± 2.5 cms. Accordingly basal area also was maximum at S4 (3.2 ± 0.5 cms) and minimum at S3 (2.7 ± 0.6 cms). The plant height seemed to have a direct influence on stem length, which was maximum (4.9 ± 1.8 cms.) at S4 and minimum at S1 (3.4 ± 1.8 cms).

However the number of branches, both primary and secondary, in plants growing at different sites did not show much variance. On an average 2 to 4 primary branches and 6 secondary branches were borne by plants. The branches showed different lengths longest (16.2 ± 2.5 cms) at S4 and shortest (10.5 ± 3.0 cms) at S2. The length of shortest branch was 4.7 ± 2.0 cms (S3) to 6.5 ± 1.2 cms. (S4).

A distinct correlation was observed between the leaf size and petiole length in the plants of this species collected from various sites.

The size of cauline leaves ranged from 29.8 ± 2.0 cms to 33.5 ± 2.8 cms being minimum at S1 and maximum at S4. The petiole attained maximum length (21.5 cms) at S4 and minimum length (10.2 cms) at S2.

Table 5. Growth performance of *Getanum phaeense* under natural habitats.

Site Plant No.	Plant height (cms.)	Basal area cm ²	Stem length cms.	No. of branches	Pri-Secondary mary dary	Length of branches Long Short cms. cms.	Petiole length (cms)	Leaf area cm ² (Cau)	No. of flowers per branch	Dia-meter of flowers	No. of fruit	Size of fruit	Length of micro-carp cms.
S ₁	31.7 +2.5	2.4 +0.7	3.4 +1.8	3	6	14.3 +1.8	5.1 +1.8	14.9 +2.2	43.2 +2.2	4	4.5	7	2.5
S ₂	24.6	3.1 +0.4	4.2 +1.0	2	4	10.5 +3.0	4.8 +1.2	10.2	30.5 +2.5	4	4.0	6	2.5
S ₃	20.7 +4.5	2.7	3.5 +1.3	2	4	11.5 +1.5	4.7 +2.0	12.5	29.8 +2.0	3	2.0	4	2.0
S ₄	45.3 +3.5	3.2 +0.5	4.9 +1.8	4	6	16.2 +2.5	6.5 +1.2	21.5	33.5 +2.8	4	2.0	8	2.0

a distinct correlation was observed between the leaf size and petiole length. The leaf size ^{radicle} ranged from a minimum of 30.5 cm² at S3 to 66.3 cm² at S4 (maximum) + 2.5. On an average each branch bore 3-4 flowers. The diameter of flowers ranged from 2.0 cms. to 4.5 cms. The size of fruit ranged from 2.0 cms. to 2.5 cms. Each fruit comprised five mericarps, each with one seed. (Table 5)

G. wallichianum: The shoot attained maximum height at S1. The vegetative growth ranged between 32.5 ± 2.5 cms. at S3 to 46.7 ± 4.0 cms. at S1 whereas at S5 the shoot length was 38.5 ± 4.0 cms. Accordingly basal area was also maximum (4.0 ± 0.7 cms.) at S1 being 3.5 ± 0.5 cms. at S3 and 3.2 ± 0.8 cms. at S5. However the length of stem was maximum (4.4 ± 1.2 cms.) at S5 and minimum (3.5 ± 0.5 cms.) at S3.

The number of primary and secondary branches borne by plants at three sites did not vary. Four primary branches were produced by plants at all the sites and number of secondary branches was 6 at S1 and S5. At S3 the number of Secondary branches was 8. The longest branch was 35.2 ± 2.5 cms. at S1 and the shortest also was at the same site (5.7 ± 1.0 cms.). At S3 maximum height was 21.2 ± 2.0 cms. The shortest branches were 5.5 ± 1.5 cms. and 3.9 ± 1.7 cms. at S3 and S5 respectively.

The size of leaves (cauline) measured in terms of length breadth ranged from 29.0 ± 2.0 cm² to 35.8 ± 2.8 cm² and length of petiole was maximum at S5 (12.5 cm²) and minimum at S1 (10.0 cm²). Thus a positive correlation between the leaf size and the length of petiole was evident.

On an average 3-4 flowers were produced by each branch. The diameter ranged from 1.5 cms. to 2.0 cms.

Table 6. Growth performance of *Getanum walllichianum* under natural habitats.

Site No.	Plant height (cms.)	Basal area cm ²	Stem length cms.	No. of branches	Pri-Secondary mary dary	Length of branches Long Short (cms)	Petiole length (cms)	Leaf area cm ² (Cau)	No. of flowers per branch	Diameter of flowers	No. of fruit	Size of fruit	Length of micro-carp cms.
S ₁	46.7 +4.0	4.0 +0.7	3.8 +0.5	4	6	35.2 +2.5	5.7 +1.0	10.0 +2.0	4	2.0	6	2.5	2.3
S ₃	32.5 +2.5	3.5 +0.5	3.5 +0.5	4	8	21.2 +2.0	5.5 +1.5	10.5 +2.2	3	1.5	6	2.5	2.3
S ₅	38.5 +4.0	3.2 +0.8	4.4 +1.2	4	6	25.2 +1.7	3.9 +1.7	12.5 +2.8	3	2.0	5	2.5	2.3

The number of fruits produced by the plants was 5 (S5) to 6 (S1 and S3). Their diameter being uniform at all the sites (2.5 cms.). The length of mericarp was uniform at all the sites (2.3 cms.). (Table 6)

G. nepalense: The maximum vegetative growth was recorded at S6 where the height on an average was 55.7 ± 3.0 cms. and at S8 of 52.5 ± 3.0 cms. At other two sites being 38.7 ± 4.0 cms. at S1 and 35.7 ± 4.0 cms. at S7. The plants with maximum height collected from S1 attained maximum basal area 4.5 ± 0.8 cms., at other sites being 4.2 ± 0.5 cms. at S8, 3.6 ± 0.6 cms. at S1 and 3.5 ± 0.5 cms. at S6.

The stem length ranged from 5.2 ± 1.2 cms. at S7 to 5.9 ± 0.6 cms. at S1. The stem length being maximum at S6, and minimum at S7, at other sites being 5.7 ± 1.5 cms. at S8 and 5.9 ± 0.6 cms. at S1. The plants produced both primary as well as secondary branches. The number of the former was uniform (4) at all the sites whereas the number of latter did vary a little; being 8 at S1, S7, S8, and only 6 at S6. The longest branch was 35.5 ± 2.5 cms. long at S6 and minimum 20.5 ± 3.0 cms. at S1 and S7. At S8 the longest branch was 35.0 ± 3.5 cms. long. However the length of shortest branch was not correlated with longest branch. The shortest branch was 9.5 ± 1.2 cms. long at S8 and 5.5 ± 2.5 cms. at S1 being 6.5 ± 2.0 cms. at S6 and 7.5 ± 1.5 cms.

Table 7. Growth performance of *Gesnerium nepalense* under natural habitats.

Site	Plant height (cms.)	Basal area cm ²	Stem length cms.	No. of branches		Length of branches		Petiole length (cms)	Leaf area cm ² (Cau)	No. of flowers per branch	Dia- meter of flowers	No. of fruit	Size of fruit	Length of micro- carp cms.
				Pri- mary	Sec- ondary	Long	Short							
S ₁	38.7 +4.0	3.6 +0.6	5.9 +0.6	4	8	20.5	5.5 +2.5	12.5	32.3 +1.0	6	1.0	12	1.5	1.5
S ₂	55.7 +3.0	4.5 +0.8	6.0 +1.0	4	6	35.5	6.5 +2.5	15.5	29.8 +1.0	4	1.0	10	1.5	1.5
S ₃	35.7 +4.0	3.5 +0.5	5.2 +1.2	4	8	20.5	7.5 +3.0	10.2	33.5 +1.2	4	1.0	12	1.5	1.5
S ₄	52.5 +3.0	4.2 +0.5	5.7 +1.5	4	8	35.0	9.5 +3.5	21.5	32.5 +1.0	4	1.0	15	1.5	1.5

The cauline leaves attained maximum size $33.5 \pm 1.2 \text{ cm}^2$ at S7. The petiole length ranged from 10.2 cms. to 21.5 cms. on an average 4-6 flowers and 10-12 fruits were produced by the plants at various sites. The size of flowers and also of the fruits was uniform at all the sites being 1.0 cms. and 1.5 cms. respectively. The length of mericarp did not vary at all being 1.5 cms. (Table 7).

G. pusillum: The plants did not attain as much height as that by *G. nepalense*, *G. wallichianum* and *G. pratense*. The maximum length of the shoot was 18.5 ± 2.0 cms. at S10. At other sites it showed a decline, the height being minimum 8.3 ± 1.5 cms. at S12. The basal area of plants recorded from three sites (S10, S11, and S13) was uniform being 4.5 ± 1.0 cms. However the basal area of plants from S9 and S6 did not vary being 4.0 ± 1.0 cms. at S6 and 3.9 ± 1.0 cms. at S9. The minimum basal area (2.5 ± 0.5 cms.) was recorded at S12.

The stem length was 2.9 ± 1.0 cms. at S12 to 5.6 ± 1.0 cms. at S9. The length of stem from S10 and S6 plants was the same (4.5 ± 1.2 cms.) where as at S11 and S13 it was 3.5 ± 1.5 cms. and 3.2 ± 1.5 cms. respectively. The number of secondary branches ranged from 6 to 8 being maximum at S10 and minimum at other sites. The leaves are borne on branches and their size ranged from $7.0 \pm 1.5 \text{ cm}^2$ to 2.0 cm^2 being minimum at S6 and maximum at S9 on an average 3 to 4 mature flowers were borne

Table 8. Growth performance of *Getanum pusillum* under natural conditions.

Site No.	Plant height (cms.)	Basal area cm ²	Stem length cms.	No. of branches	Pri-Secondary mary dary	Length of branches Long Short cms. cms.	Petiole length (cms)	Leaf area cm ² (Cau)	No. of flowers per branch	Dia-meter of flowers	No. of fruit	Size of fruit	Length of micro-carp cms.
S ₆	12.5 ±2.2	4.0 ±1.0	4.5 ±1.2	4	6	6.2 ±0.5 2.6 ±0.2	7.8	7.0 ±1.5	3	0.3	5	0.7	0.5
S ₉	11.2 ±2.7	3.9 ±1.0	5.6 ±1.0	4	6	4.9 ±0.2 3.3 ±0.2	5.9	11.3 ±2.0	4	0.5	10	1.0	0.5
S ₁₀	18.5 ±2.0	4.5 ±1.2	4.5 ±1.5	4	8	8.2 ±1.2 5.5 ±0.5	9.0	11.2 ±2.0	3	0.5	8	1.0	0.5
S ₁₁	14.2 ±2.5	4.5 ±1.0	3.5 ±1.5	3	6	4.5 ±0.2 2.2 ±0.2	7.2	10.8 ±1.5	2	0.3	10	1.0	0.5
S ₁₂	8.3 ±1.5	2.5 ±0.5	2.9 ±1.0	3	6	4.3 ±0.3 1.5 ±0.1	6.7	10.8 ±1.0	3	0.3	5	0.5	0.5
S ₁₃	14.5 ±1.2	4.5 ±1.0	3.2 ±1.5	3	6	5.7 ±1.0 2.5 ±0.2	6.5	14.2 ±1.2	4	0.5	12	0.5	0.5

on branches. Since plants are collected at different phenophases the exact number of flowers produced by plants at different sites could not be recorded because some flowers were immature, some were shrivelled and some had matured into fruits. The diameter of flowers ranged from 0.3 cms. to 0.5 cms. being minimum at S6, S10 and S12 and maximum at S9, S10 and S13. The number of fruits could not be recorded exactly because some were unripe, some abortive and some had already dehisced. The size of fruits ranged between 0.5 cms. (S12 and S13) and 1.0 cms. (S9, S10 and S11). At S6 the size of fruits was 0.7 cms. (Table 8).

Transplant Experiments

Under transplant conditions the plants of *G. pratense* attained the height of 28.5 ± 2.5 cms., being less than that in nature. The basal area was 2.5 ± 0.5 cms. and stem length taken as a relative measure of growth was only 3.2 ± 1.0 cms. However the number of branches produced by the plants was 4 primary and 6 secondary, the length of primary branch was 12.5 ± 2.5 cms and that of secondary was 6.2 ± 1.0 cms. The petiole also did not attain as much height as was attained under natural habitats being only 12.0 cms. and the leaf area was 39.6 ± 2.5 cms. on an average plants produced four flowers per branch and total number of fruits per flower was five. The diameter of flowers was 4.5 cms. and size of fruit was 2.5 cms.

The height of *G. wallichianum* plants was 30.2 ± 2.7 cms. under transplant conditions. The basal area was 3.0 ± 0.7 cms. and stem measured 3.5 ± 0.8 cms. in length on the whole vegetative growth of this plant under transplant conditions was less than that was recorded in natural habitats. The number of branches both primary as well as secondary did not vary being 4 and 6 and their length was 1.82 cms. and 8.0 cms. respectively. The petioles also did not attain maximum height being only 8.5 cms. The length of petiole seemed to have considerable influence over the size of leaves. The shorter petioles produced leaves whose size was less being 29.2 ± 1.8 cms. only. The number of flowers per branch was only 3, and their diameter was 1.5 cms. The number of fruits produced by the plants was 4. The size of fruit was 2.5 cms.

The plants of *G. nepalense* did not attain as much height under transplant conditions as was attained by these plants under natural habitats. The height was 25.5 cms. only and basal area was 3.5 ± 0.8 cms. The length of stem was 4.2 ± 0.6 cms., but there was no variation in the number of branches produced by the plants, 4 primary and 8 secondary branches were borne by the plants under transplant conditions. Their length being 15.2 and 7.5 respectively. The size of leaves $+1.5\text{cms (cauline)}+1.0\text{cms}$ was $23.8 \pm 1.0\text{cm}^2$ and these were borne

Table 9 . Growth performance of *Gehlanium* species under transplant conditions.

Species Name	Plant height (cms.)	Basal area cm ²	Stem length cms.	No. of branches Pri- Secondary	Length of branches Long Short cms. cms.	Petiole length (cms)	Leaf No. of flowers cm ² per (Cau) branch	No. of fruit flowers	Size of fruit cms.	Length of micro-carp cms.				
<i>G. pratense</i>	28.5 +2.5	2.5 +0.5	3.2 +1.0	4	6	12.5 +2.5	6.2 +1.0	12.0	39.6 +2.5	4	4.5	5	2.5	2.3
<i>G. dalli-chianum</i>	30.2 +2.7	3.0 +0.7	3.5 +0.8	4	6	18.2 +2.0	8.0 +1.5	8.5	29.2 +1.8	3	1.5	4	2.5	2.3
<i>G. nepalense</i>	25.5 +2.2	3.5 +0.8	4.2 +0.6	4	8	15.2 +1.5	7.5 +1.0	15.0	23.8 +1.0	4	1.0	8	1.5	1.5
<i>G. pusillum</i>	12.5 +1.2	2.8 +0.5	2.5 +0.5	3	6	6.5 +1.0	3.2 +0.5	7.5	10.8 +0.5	4	0.3	5	0.5	0.3

on long petioles (15.0 ± 1.0 cms.). On an average plants produced four flowers per branch and 8 fruits per plant at the time of collection. The diameter of flowers being 1.5 cms., and size of fruits 1.0 cms.

Since botanic garden is the suitable site for the growth of *G. pusillum* plants no remarkable variation was observed in the growth parameters of these plants both under natural habitats and under transplant conditions. The plants attained the height of 12.5 ± 1.2 cms. their basal area being 2.8 ± 0.5 cms. and the length of stem was 2.5 ± 0.5 cms. The number of primary and secondary branches borne by the plants was 3 and 6. Their length being 6.5 cms. and 3.2 cms. respectively. The leaf size was 10.8 ± 0.5 cms², and these were borne on long petioles (7.5 ± 0.5 cms) plants bore 4 flowers per branch, their diameter was 0.3 cms, being same as was recorded at other sites (natural habitats). On an average the number of fruits (mature) produced by the plants was five and their size was 0.5 cms. (Table 9).

G R O W T H P E R F O R M A N C E
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C O N T R O L L E D C O N D I T I O N S

G. pusillum

Culture Experiments: In culture experiments *G. pusillum* and *G. nepalense* alone were considered; the objective being to study the growth performance under controlled conditions of irrigation, light, edaphism, weed competition and organic manuring.

G. pusillum : The seeds to germinate were sown in polythelene bags using garden soil. The seeds were transplanted in different perforated bags and kept for further observations as detailed below:

A. Growth performance in relation to varying irrigation practices (W₁, W₂, W₃ & W₄): The root length was 4.6 + 0.5 cms. minimum in the plants watered after 12 days interval (W₄) and 6.0 + 0.9 cms. (maximum) watered after 2 days interval (W₁). The other two (W₂, W₃) sets did not vary much in their root length being 4.8 + 0.2 cms. in the plants watered after 4 days (W₂) interval and 4.7 + 0.2 cms. those watered after 8 days interval (W₃). The shoot length was maximum (20.0 + 2.0 cms) in W₁ set and minimum (14.0 + 2.5 cms) in W₄. In the W₃ set 14.5 + 0.6 cms was the length of shoot and in W₄ set 14.0 + 2.5 cms.

The number of branches primary as well as secondary was uniformly 2 (primary) and 4 (secondary). The primary branches attained maximum length (5.8 + 1.8 cms.) in W₁ set and minimum (4.0 + 0.5 cms) in W₃ set, where as

secondary branches attained the length 7.5 ± 1.4 cms. and 9.0 ± 0.8 are being minimum in W4 and maximum at W3.

The area of radical leaf was same in W1 and W2 set being $(8.8 \pm 1.0 \text{ cm}^2)$ but in sets W3 and W4 it was $6.6 \pm 0.8 \text{ cm}^2$ and 11.2 cm^2 respectively. The cauline leaves attained maximum size in W4 set ($10.9 \pm 1.8 \text{ cm}^2$ and minimum in W1 set $8.9 \pm 1.2 \text{ cm}^2$).

On an average plants produced 36 leaves in W1, 30 leaves in W2, 28 leaves in W3 and 20 leaves in W4 set. The number of flowers borne by plants was 16 in W1 (maximum) reduced to only 10 in W3 and W4 and 12 in W2. However the diameter of flowers did not vary at all being uniform in all the sets (0.5 cms.).

The maximum fruits 15 were produced in W2 11 in W1, 14 in W3 and 12 in W4 sets. Since each fruit produces five seeds the number of seeds available from these plants was 55 (W1) 75 (W2), 70 (W3) and 60 (W4).

The average seed weight calculated (by weighing 100 seeds) was 0.058 gms. (W4) 0.055 gms. (W2 and W3) and 0.056 gms. (W1) being maximum in the plants watered after 12 days and minimum in those watered after 4 days and 8 days interval.

The maximum fresh weight of both root and shoot calculated in these plants watered after every 2 days

Table 10. Growth performance of *G. pusillum* in relation to varying irrigation.

Site	Root length cms	Shoot length cms	Branches		Length of branches		Leaf area		Av. leaf No./plant	No. of flowers per plant	Dia. of flowers	No. of fruit per plant	No. of seeds per plant	Av. seed wt. gms	Dry root wt. gms	Dry shoot wt. gms	Fresh root wt. gms	Fresh shoot wt. gms
			Pri. cms	Sec. cms	Pri. cms	Sec. cms	Radical cms ²	Cauline cms ²										
W ₁	6.0 ±0.9	20.0 ±2.0	2	4	5.8 ±1.8	8.2 ±0.8	8.8 ±1.0	8.97 ±1.2	36	16	0.5	11	55	0.056	0.195	2.100	0.510	2.500
W ₂	4.8 ±0.2	18.5 ±0.6	2	4	4.8 ±0.2	8.2 ±0.6	8.8 ±1.0	10.8 ±1.5	30	12	0.5	15	75	0.055	0.205	1.155	0.450	1.750
W ₃	4.7 ±0.2	14.5 ±0.6	2	4	4.0 ±0.5	9.0 ±0.8	6.6 ±0.8	8.7 ±1.0	28	10	0.5	14	70	0.055	0.095	1.005	0.295	1.685
W ₄	4.6 ±0.5	14.0 ±2.5	2	4	4.8 ±0.3	7.5 ±1.4	11.2 ±1.5	10.9 ±1.8	20	10	0.5	12	60	0.058	0.090	0.950	0.170	1.580

(W1) interval being 0.510 gms. where as plants watered after every 12 days (W4) interval recorded the minimum fresh weight of root and shoot as $\frac{0.170}{1.580}$ gms.

In other two sets the fresh weight of root and shoot was 0.450/1.750 gms (W2) and 0.295/1.685 (W3). The dry weight of these plants (oven dried) both root and shoot was 0.195/2.100 gms in W1, 0.205/1.155 gms W2, 0.095/1.005 in W3 and 0.090/0.950 in W4. Thus the maximum dry weight of root was shown by W2 and the minimum in W4. The dry weight of shoot was maximum in W1 and minimum in W4 (Table 10)

B. Growth performance in relation to varying lights:

The plants grown in polythelene bags were subjected to different lights: Sun, medium and deep shade, and bags labelled accordingly as GpL1, L2, & L3. The roots attained maximum length (4.2 ± 1.2 cms) in L1 and minimum in L3 (3.0 ± 0.6 cms). In medium shade the roots were 4.2 ± 0.2 cms long. In medium shade (L2), the shoot length was 20.5 ± 1.5 cms. being the maximum, where as in Deep shade L3 the shoots did not attain much length being only 14.2 ± 2.5 cms.

The number of primary and secondary branches borne in L1 & L3 did not vary at all being 2 and 4 respectively But in L₂ these were 4 and 8 respectively. The length of primary branches was maximum in L2 (4.2 ± 0.2 cms) and minimum in L1 (3.2 ± 0.6 cms). In L3 set the length

was 3.4 ± 0.8 cms. The length of secondary branches ranged between 5.0 ± 0.4 cms. (L3) to 10.9 ± 1.9 cms. (L2) being minimum under deep and maximum under medium shade.

The area of radical leaves (lxb) was 7.0 ± 0.8 cm² in L1 and L2 and 7.7 ± 0.8 cm² in L3. The area of cauline leaves did not vary in L1 and L3 being 4.0 ± 0.3 cm² whereas in L2 set it was 6.4 ± 0.6 cm².

The plants grown in medium shade (L2) produced maximum number of leaves (28) where as those were 18 in L1 and 10 in L3. The number of flowers was maximum in L2 (12) and minimum in L3 (6) where as plants grown in sun (L1) produced 8 flowers. However the diameter of these flowers was uniform (0.5 cms) in all the three sets.

The plants growing in medium shade (L2) produced maximum number of fruits (24), in L1 these were 18 and in L3 12. L2 produced 120 seeds (maximum), L1, 90 and L2 60 (minimum).

The average seed weight (100 seeds) was 0.058 gms. in L2, 0.053 gms. in L1 and 0.050 gms in L3.

The fresh weight of root in L2 and L3 was maximum (0.060 gms.) and in L1 it was 0.040 gms. The fresh weight of shoot ranged between 0.400 gms. (L3) and 0.750 (L2). In L1 it was 0.600 gms.

Table 11. Growth performance of *Geranium pusillum* in relation to varying light.

Site	Root length cms	Shoot length cms	Branches		Length of branches		Leaf area		Av. leaf	No. of	Dia. of	No. of	No. of	Av.	Dry	Dry	Fresh	Fresh
			Fri.	Sec.	Fri.	Sec.	Radical	Cauline	No./plant	flowers	flowers	fruit	seeds	seed	wt.	wt.	wt.	wt.
			cms	cms	cms	cms	cms ²	cms ²		per	per	per	per	wt	wt.	wt.	wt.	wt
									plant	plant	plant	plant	plant	gms	gms	gms	gms	gms.
L ₁	4.2 ±1.2	18.2 ±2.4	2	4	3.0 ±0.6	9.1 ±1.2	7.0 ±0.8	4.05 ±0.3	18	8	0.5	18	90	0.053	0.025	0.065	0.040	0.600
L ₂	4.2 ±0.2	20.5 ±1.5	4	8	4.2 ±0.2	10.9 ±1.9	7.0 ±0.5	6.4 ±0.6	28	12	0.5	24	120	0.058	0.030	0.070	0.060	0.750
L ₃	3.0 ±0.6	14.2 ±2.5	2	4	3.4 ±0.8	5.0 ±0.4	7.7 ±0.8	4.05 ±0.3	10	6	0.5	12	60	0.050	0.010	0.055	0.060	0.400

The maximum dry weight of root and shoot was 0.030/0.070 gms. in L2. It was minimum in deep shade (L3), (0.010/0.055 gms.) but in those growing in sun (L1) it was 0.025/0.065 gms. (Table 11).

Growth performance in relation to varying soil texture:

The different types of soils used were garden soil (T1), Karewa soil (T2), Garden soil + Sand (T3), Orchard soil (T4) and paddy soil (T5).

The maximum root length was in T4 (7.2 ± 0.2 cms.) and minimum in T2 (2.2 ± 0.2 cms.). In T1 it was 3.7 ± 0.2 cms, in T3 3.8 ± 0.2 cms and in T5 3.0 ± 0.3 cms, The shoot length was 32.1 ± 1.7 cms. in T4 (maximum) and 15.6 ± 3.2 cms. in T2 (minimum). In T₂ it was 15.6 ± 3.2 cms. and in T3 25.9 ± 0.3 cms. and in T5 16.5 ± 0.5 cms. The number of primary and secondary branches was maximum (6 and 12) in T1, whereas in T2, T3 and T5, 2 and 4 respectively. T4 produced 4 primary and 8 secondary branches. The length of primary branches was 4.2 cms. (T1), 2.5 cms. (T2), 3.6 cms. (T3) 3.0 cms. (T4) and 2.5 cms. (T5). The length of secondary branches was 4.8 cms. in T1, 5.5 cms. in T2, and T3 6.2 cms. in T4 and 3.5 cms. in T5, maximum in T4 and minimum in T5.

The area of radical leaves did not show much variance being 3.75 ± 0.3 cms² in T1, T3, and T4 and 1.50 ± 0.2 cm²

in T2 and T5. The area of cauline leaves was uniform $6.0 \pm 1.0 \text{ cm}^2$ in T1, T3 and T4, in T2 and T5 it was $3.75 \pm 0.8 \text{ cm}^2$. On an average T1 set produced 60 (maximum) leaves, 30 in T4, 15 in T2 and T3 and 10 in T5. The number of flowers produced was maximum in T1 (48 flowers) and minimum T5 (6 flowers). It was 30 in T4, 12 in T2 and only 6 in T5. The diameter of flowers was uniform in all the sets (0.5 cms.).

The maximum fruits produced were 36 in T1, 22 in T4, 10 in T2 and T5 in T3. The maximum seeds were 180 in T1, in T2 and T5 50, and 75 and 110 in T3 and T4 respectively. On an average seeds weighed (100 seeds) 0.055 gms (T1), 0.045 gm (T2), 0.056 gm (T3), 0.058 gms (T4) and 0.050 gms (T5). The fresh weight of root was 0.095 gms. in T1, 0.060 gms in T2, 0.055 gms in T3, 0.095 gms in T4 and 0.045 gms in T5. The fresh weight of shoot was 0.275 gms (T5) and 0.675 gms in T1, 0.425 gms in T2, 0.560 gms in T3 and 0.580 gms in T4. Thus the maximum fresh weight of shoot was in T1 and the minimum in T5. The plants were oven dried at 105°C for 24 hrs. and dry weight of both root and shoot was calculated. The dry weight of root was 0.020 gms. in T1 and T3, 0.010 gms in T2, 0.050 gms in T4 and 0.015 gms in T5. The dry weight of shoot was 0.015 gms in T5. The dry weight of shoot was 0.085 gms (T5) to 0.170 gms (T1) whereas in T3 and T4 it was 0.125 gms and in T2 0.095 gms respectively (Table 12).

Table 12. Growth performance of *Geranium pusillum* in relation to varying soil texture.

Site	Root length cms	Shoot length cms	Branches Pri. cms Sec. cms	Length of branches Pri. Sec.	Leaf area Radical cms ² Cauline cm ²	Average leaf No./plant	No. of flowers per plant	Dia. of flowers	No. of fruit per plant	No. of seeds per plant	Average seed wt. gms	Dry wt. gms	Dry shoot wt. gms	Fresh wt. gms	Fresh wt shoot gms			
T ₁	3.7 ±0.2	30.2 ±2.0	6	12	4.2 ±0.2	4.8 ±0.2	3.75 ±0.3	6.0 ±1.0	60	48	0.5	36	180	0.055	0.020	0.170	0.085	0.575
T ₂	2.2 ±0.2	15.6 ±3.2	2	4	2.5 ±0.3	5.5 ±0.2	1.50 ±0.2	3.75 ±0.5	15	12	0.5	10	50	0.045	0.010	0.095	0.060	0.425
T ₃	3.8 ±0.2	25.9 ±0.3	2	4	3.6 ±0.2	5.5 ±0.8	3.75 ±0.4	6.00 ±1.0	15	10	0.5	15	75	0.056	0.020	0.125	0.055	0.560
T ₄	7.2 ±0.2	32.1 ±1.7	4	8	3.0 ±0.2	6.2 ±0.2	3.75 ±0.2	6.00 ±1.0	30	30	0.5	22	110	0.058	0.050	0.125	0.095	0.580
T ₅	3.0 ±0.3	16.5 ±0.5	2	4	2.5 ±0.2	3.5 ±0.5	1.50 ±0.2	3.75 ±0.8	10	6	0.5	10	50	0.050	0.015	0.085	0.045	0.275

Growth performance in relation to Weed competition

The seeds were grown in polythelene bags alongwith weeds. The number of weeds planted as associates in the bags was 1, 2, 3 and 4 respectively. The maximum length of root was in C1 (8.2 ± 0.6 cms.). It was 4.7 ± 0.2 cms in C4 showed decline. In C2 and C3 it was 8.0 ± 0.4 cms and 5.5 ± 0.3 cms respectively. The shoots attained maximum height (36.8 ± 3.6 cms) in C1. It was 31.6 ± 0.9 cms, 25.2 ± 0.5 cms and 22.5 ± 0.8 cms respectively in C2, C3 and C4. The number of primary as well as secondary branches was 4, and 8 in C1, only 2 and 4 in other three sets. The primary branches attained maximum length in C1 (3.7 ± 0.2 cms), whereas the same was attained by the secondary branches in C2 (6.5 ± 0.3 cms) The minimum length of primary branches was in C2 (2.5 ± 0.1 cms) and that of secondary in C3 (3.0 ± 0.2 cms).

The area of radical leaves did not vary much in C1 being 7.70 ± 1.0 cm², in C2 7.04 ± 0.8 cm² and in C3 and C4 6.0 cm². The cauline leaves did not show remarkable variation in their area being 7.70 ± 1.2 cm² in C1 and 6.0 ± 0.9 cm² in C2, C3 and C4.

On an average plants produced 28 leaves in C1 (maximum) 20 in C2, 18 in C3 and 12 in C4 (minimum). The maximum flowers (32) were produced in competition with one weed (C1), 30 with two weeds and 21 and 14 with three and

Table 13. Growth performance of *Geranium pusillum* in relation to weed competition.

Site	Root length cms	Shoot length cms	Branches Pri. cms	Sec. cms	Length of branches Pri. Sec.	Leaf area Radical cms ²	Cauline cm ²	Average leaf No./plant	No. of flowers per plant	Dia. of flowers	No. of fruit per plant	No. of seeds per plant	Average seed wt gms	Dry wt. root gms	Dry wt. shoot gms	Fresh wt. root gms	Fresh wt shoot gms	
C ₁	8.2 ±0.6	36.8 ±3.8	4	8	3.7 ±0.2	5.5 ±0.3	7.70 ±1.0	7.70 ±1.6	28	32	0.5	18	90	0.055	0.030	0.355	0.060	0.750
C ₂	8.0 ±0.4	31.5 ±0.9	2	4	2.5 ±0.1	6.5 ±0.3	7.04 ±0.8	6.00 ±0.9	20	30	0.5	14	70	0.050	0.025	0.225	0.045	0.660
C ₃	5.5 ±0.3	25.2 ±0.5	2	4	3.2 ±0.2	3.0 ±0.2	6.00 ±0.5	6.00 ±0.6	18	21	0.5	10	50	0.050	0.025	0.210	0.050	0.410
C ₄	4.7 ±0.2	22.5 ±0.8	2	4	2.7 ±0.2	5.7 ±0.2	6.00 ±0.5	6.00 ±0.6	12	14	0.5	8	40	0.050	0.025	0.210	0.060	0.450

four weeds respectively. The diameter of flowers was 0.5 cms in all the four sets. The maximum number of fruits were produced in C1 set (8), 14 in C3 and only 8 in C4. The total number of seeds was 90 in C1, 70 in C2, 50 in C3 and 40 in C4. However the maximum weight of seeds (100 seeds) was from C1 (0.055 gms), being 0.050 gms, in the other three sets. The maximum fresh weight of root and the shoot of both the genus and the weed was 0.060 gms. in C1 and 0.750 gms. respectively. The minimum in C2 (0.045 gms. and 0.410 gms. respectively). In C3 the same was 0.050 gms. and 0.660 gms. respectively and in C4 0.060 gms. and 0.480 gms. The maximum dry weight of root and shoot in C1 was 0.030 gms. and 0.355 gms. respectively where as the minimum dry weight of root was in C3 (0.025 gms.) and shoot (0.210 gms). In C2 and C4 dry weight of root was uniform (0.025 gms.) where as in C3 the dry weight of shoot was 0.210 gms. and in C4 0.210 gms. (Table 13).

Growth performance in relation to organic manure:

Sown in polythelene bags using garden soil to which organic manure in the proportion of 30%, 50% and 70% was added. The bags were labelled as M1, M2 and M3. The root length was maximum (7.9 ± 0.4 cms.) in M1, 6.7 ± 0.8 cms. in M2 and 6.8 ± 0.4 cms. in M3. However the shoot length was maximum (39.4 ± 0.8 cms.) in M3 and minimum in M2 (29.7 ± 2.4 cms.). In M1 the shoot length

was 37.6 ± 1.9 cms. The number of primary and secondary branches did not vary being 4 and 8 respectively. The area of radical leaves was 6.4 cm^2 in M1, 7.70 cm^2 in M2, and 7.0 cms. in M3 but the cauline leaves did not show any variation being $6.4 \pm 0.8 \text{ cm}^2$ in all the three sets. On an average the number of leaves borne by plants was maximum (32) in M1 and minimum (22) in M2 and M3 it was 28. The number of flowers in M3 set was 18, in M2 14 while as in M1 16.

However the diameter of flowers was uniform (0.5 cms.) in all the plants. The maximum number of fruits were recorded in M3 set (23) and 22 and 18 in M1 and M2 set respectively. The 115 seeds were collected from M3, 110 seeds from M1 and 90 from M2 set. The seed weight calculated (100 seeds) did not vary at all (0.055 gms) in all the three sets. The M2 showed maximum fresh weight and dry weight of roots being 0.210 gms. and 0.120 gms. respectively. It was 0.140 gms. in M1, 0.135 gms. in M3. The dry weight of root was 0.070 gms. in M1 and 0.085 gms. in M3. The maximum fresh weight of shoot in case of M3 was (1.682 gms.) and in M2 the minimum (1.407 gms.). In M1 the fresh weight of shoot was 1.330 gms. The dry weight of shoot was 0.895 gms (M2 set) to 0.875 gms (M1 set). Dry weight of shoot calculated in M3 was 0.950 gms. (Table 14; Plate 6-8).

Table 14. Growth performance of *Geranium pusillum* in relation to organic manure.

Site	Root length cms	Shoot length cms	Branches Pri. cms Sec. cms	Length of branches Pri. Sec.	Leaf area Radical cms ² Cauline cms ²	Average leaf No./plant per plant	No. of flowers per plant	Dia. of flowers per plant	No. of fruit per plant	No. of seeds per plant	Average seed wt gms	Dry wt. root gms	Dry wt. shoot gms	Fresh wt. root gms	Fresh wt. shoot gms
M ₁	7.9 ±0.4	37.6 ±1.9	4 8	4.0 5.0	6.40 6.4 ±0.8	32	16	0.5	22	110	0.055	0.070	0.875	0.190	1.330
M ₂	8.2 ±0.8	38.2 ±2.4	4 8	2.8 4.2	7.70 6.4 ±0.8	32	18	0.5	20	100	0.055	0.120	0.695	0.210	1.407
M ₃	8.5 ±0.4	39.4 ±0.8	4 8	3.5 5.2	7.00 6.4 ±0.5	38	18	0.5	24	120	0.055	0.085	0.950	0.235	1.682

Plate 6 - Growth performance of *Geranium pusillum*
in relation to
a - Varying irrigation practices
b - Varying lights



Plate 6

Plate 7 - Growth performance of *Geranium pusillum*
in relation to
a - Varying soil texture
b - Weed competition



Plate 7

plate 8 - Growth performance of *Geranium pusillum*
in relation to organic manure.



Plate 8

G R O W T H P E R F O R M A N C E
U N D E R
C O N T R O L L E D C O N D I T I O N S

G. nepalense

Growth performance in relation to varying irrigation practices : *G. Nepalense*:

The plants of *G. Nepalense* grown in polythene bags were watered at every 2, 4, 8 and 12 days interval and labelled accordingly as W1, W2, W3 and W4.

The roots of W1 and W2 attained similar length (9.0 + 0.5 cms). But in W3 and W4 it was 8.3 + 1.1 cms and 8.5 + 0.7 cms. respectively. The shoot length was maximum 32.5 + 3.2 cms. in W1 and minimum 25.0 + 2.8 cms. in W4. However in W2 and W3 it was 30.5 + 2.5 cms and 27.3 + 1.9 cms respectively. The number of primary branches was 4 in W1, W2 and W3 and 2 in W4, the number of secondary branches was 8 in W1, W2 and W3 and 4 in W4.

The primary as well as secondary branches attained maximum length in W2 being 15.5 cms (primary) and 9.2 cms. (secondary) respectively. The minimum length of primary branch was in W4 (12.5 cms), and secondary branch 6.2 cms. In W1 and W3 the branches did not vary much 13.5 cms (primary) and 7.4 cms (secondary) in former and 13.0 cms (primary) and 7.2 cms (secondary) in the latter set.

The leaf area (radical) in W1 and W4 was 26.04+2.5 cm and 25.2+2.0 cm² in W2, and 24.0+2.0 cm² in W3. The area

of cauline leaves was $23.0 \pm 2.0 \text{ cm}^2$ in W1 and W2 and $16.5 \pm 1.2 \text{ cms}^2$ in W4.

On an average the plants produced 30 leaves (maximum) in W1 and W2 and 20 leaves in W3 and W4. The total number of flowers produced was 10 in W1 and W2 and 8 in W3 and W4.

However the diameter of flowers was uniform in all the four sets (1.0 cm). Despite the fact that plants grew healthy and tall, they did not produce many fruits. The maximum (8) fruits were produced in W3 and 7 in W1 and only 6 in W2 and W4. The total seeds produced were 30 in W2 and W4, 40 in W3 and 35 in W1. The seeds weighed 0.070 gms (Average 100 seeds set) in all the four sets.

The fresh wt. of root and that of shoot was maximum in W1, root weighed 0.550 gms. and shoot 4.425 gms. In W2 the root and shoot weight was minimum, being 0.210 gms. (root) and 2.425 gms (Shoot).

In W3 and W4 the fresh wt. of root was 0.300 gms, where as shoot weighed 3.175 gms. and 3.150 gms respectively. The maximum dry wt. of root and shoot was in W1, root weighed 0.305 gms. and shoot weighed 1.310 gms. In W2 the root and shoot weighed 0.150 gms. and 1.110 gms. respectively, and in W3 and W4 the dry wt. of root was 0.155 gms. but dry wt. of shoot did vary being 1.105 gms. in W3 and 1.100 gms. in W4 (Table 15).

Table 15. Growth performance of *Geranium nepalense* in relation to varying irrigation.

Site	Root length cms	Shoot length cms	Branches		Length of branches		Leaf area		Av. leaf	No. of	Dia. of	No. of	No. of	Av.	Dry	Dry	Fresh	Fresh
			Pri.	Sec.	Pri.	Sec.	Radical	Gauline	No./plant	flowers	flowers	fruit	seeds	seed	wt.	wt.	wt.	wt.
			cms	cms	cms	cms	cms ²	cms ²		per	per	per	per	wt	root	shoot	root	shoot
										plant	plant	plant	plant	gms	gms	gms	gms	gms
W ₁	9.0 ±0.4	32.5 ±3.2	4	8	15.5 ±1.5	9.4	26.04 ±2.5	23.01 ±2.0	30	10	1.0	7	35	0.070	0.305	1.310	0.550	4.425
W ₂	9.0 ±0.5	30.5 ±3.2	4	8	13.5	7.2	25.2 ±2.0	23.01 ±2.0	30	10	1.0	6	30	0.070	0.150	1.110	0.210	2.425
W ₃	8.3 ±1.1	27.3 ±1.9	4	8	13.0	7.2	24.0 ±2.0	17.7 ±1.5	20	8	1.0	5	25	0.070	0.155	1.105	0.300	3.175
W ₄	8.5 ±0.7	25.0 ±2.8	2	4	12.5	6.2	26.4 ±2.5	16.5 ±1.2	20	8	1.0	5	25	0.070	0.155	1.100	0.300	3.150

Growth performance in relation to varying lights:

The plants in perforated polythene bags and kept for growth in lights viz. Sun, medium, deep shade and bags labelled as L1, L2 and L3.

The length of root portion did not vary much in L1 and L3 being 9.6 ± 0.5 cms. and 9.2 ± 0.3 cms. respectively. In L2 length was lesser 8.9 ± 0.5 cms. The shoot length did vary being 15.5 ± 1.5 cms. in L3 (minimum) and 34.6 ± 20 cms. in L2 (maximum). The shoot was 25.6 ± 2.5 cms. long. The number of primary and secondary branches was maximum in L1 (4 and 8) whereas in L2 and L3 these were 2 and 4 respectively. The primary branches attained maximum length (12.7 cms.) in L2 and minimum (8.5 cms) in L3. In L1 the length was 12.6 cms. The secondary branches attained minimum length in L3 (5.0 cms) and in L1 and L2 it was 7.4 cms. and 6.4 cms. respectively.

The area of radical leaf was 27.3 ± 2.5 cm² in L1, 27.90 ± 2.5 cm² in L2, and 21.09 ± 2.0 cm² in L3. However the flowering was not prolific being 6 in L1 set, 10 in L2 and 8 in L3. The diameter of flowers was rather uniform being 1.0 cms.

The maximum number of fruits was 10 in L2 and 6 in L1 and L3. The total number of seeds in L1 was 30, in L2 50 and in L3 30. The seed weight (100 seeds).

Table 16. Growth performance of *Geranium nepalense* in relation to varying lights . :

Site	Root length cms	Shoot length cms	Branches Pri. Sec. cms cms	Length of branches Pri. Sec. cms cms	Leaf area Radical Cauline cms ² cm ²	Average leaf No./plant per plant	No. of flowers per plant	Dia. of flowers per plant	No. of fruit per plant	No. of seeds per plant	Average seed wt gms	Dry wt. root gms	Dry wt. shoot gms	Fresh wt. root gms	Fresh wt shoot gms	
L ₁	9.6 ±0.5	25.6 ±2.5	4 8	12.6 7.4	27.30 ±2.5	21.09	16	6	1.0	6	30	0.060	0.800	2.750	2.640	8.425
L ₂	8.9 ±0.5	34.6 ±2.0	4 8	12.7 6.4	27.90 ±2.5	23.4	22	10	1.0	10	50	0.062	0.850	3.590	2.720	8.520
L ₃	7.2 ±0.3	15.5 ±1.5	2 4	8.5 5.0	21.09 ±2.0	21.83	12	8	1.0	6	30	0.060	0.680	2.100	2.400	5.250

On an average was 0.060 gms. in L1 and L3, 0.062 gms. in L2 being the maximum.

The fresh wt. of root was maximum in L2 (2.720 gms.) and minimum in L3 (2.400 gms.). In L1 it was 2.640 gms. The fresh weight of shoot was 8.529 gms. in L2 (maximum) and 5.250 gms. in L3 (minimum), in L1 it was 8.425 gms. Thus L2 showed maximum dry wt. (0.800 gms. and 5.750 gms. respectively).

The dry wt. of root was 0.850 gms. (maximum) in L2 and 0.680 in L3 set (minimum), and dry wt. of shoot was 3.590 gms. in L2, 2.750 gms. in L1 and 2.100 gms in L3 (Table 16).

Growth performance in relation to Organic manure:

The plants were sown in polythene bags using garden soil to which different proportion 30%, 50% and 70% of organic manure added and bags labelled as Gnep M1, M2 and M3 set. The length attained by roots did not vary much 9.0 ± 0.5 cm in M1, 9.3 ± 0.5 cms. and 9.4 ± 0.7 cm in M2 and M3. The shoot attained maximum length in M3 being $(34.2 \pm 2.5$ cms) and minimum in M1 $(27.7 \pm 2.1$ cms). In M2 it was 30.9 ± 1.6 cms.

However the number of branches produced by these plants in all the three sets did not vary at all. The plants produced four primary and 8 secondary branches.

The primary branches showed great variation in their length : 12.5 cms. to 18.3 cms. Whereas secondary branches did not show much variation : almost uniform, 8.5 cm (M1) 8.2 cms (M2) and 8.9 cm (M3).

The area of radical leaves was same in M2 and M3 $24.0 \pm 2.0 \text{ cm}^2$ but in M1 it was $25.2 \pm 2.2 \text{ cm}^2$. The cauline leaves did show variation in their area $20.88 \pm 1.5 \text{ cm}^2$ in M1 and $22.32 \pm 1.5 \text{ cm}^2$ in M2 and $19.25 \pm 1.2 \text{ cm}^2$ in M3. Maximum leaves were produced in M2 (27) and minimum (22) in M1 and 24 in M2. The flowers/plant were 18 in M1, 12 in M2, 14 in M3.

It was observed that the number of fruits was 10 in M1 and only six in M2 and M3. Accordingly the number of seeds collected were 50 in M1, 30 in M2 and in M3. The average seed weight (100 seeds) was 0.065 gms.

The maximum fresh weight of roots was recorded in M3 (0.610 gms) and minimum in M2 (0.550 gms). In M1 roots weighed 0.570 gms. when fresh. However dry weight of roots was maximum in M1 (0.235 gms) and minimum in M3 (0.210 gms). In M2 it was 0.225 gms. The fresh weight of shoot also was maximum in M2 (3.790 gms) in M1 and M3, it was 2.525 gms, and 3.750 gms respectively.

The shoot portions of these plants after drying recorded considerable loss of weight, being 2.005 gms in M3, 1.450 gms in M2 and as low as 1.110 gms in M1 (Table 17).

Table 17. Growth performance of *Geranium nepalense* in relation to organic manure.

Site	Root length cms	Shoot length cms	Branches Pri. Sec. cms cms	Length of branches Pri. Sec. cms cms	Leaf area Radical Cauline cms ² cms ²	Av. leaf No./plant	No. of flowers per plant	Dia. of flowers per plant	No. of fruit per plant	No. of seeds per plant	Av. Dry seed wt. gms	Dry root wt. gms	Dry shoot wt. gms	Fresh root wt. gms	Fresh shoot wt. gms
M ₁	9.0 ±0.5	27.2 ±2.1	4 8	15.3 8.5	25.2 20.8 ±2.2 ±1.5	24	18	1.0	10	50	0.065	0.235	1.110	0.570	2.525
M ₂	9.3 ±0.5	30.9 ±1.6	4 8	12.5 8.2	24.0 22.3 ±2.0 ±1.5	22	12	1.0	6	30	0.065	0.225	1.450	0.550	3.790
M ₃	9.4 ±0.7	34.3 ±2.5	2 8	18.3 8.9	24.0 19.2 ±2.0 ±1.2	22	14	1.0	6	30	0.065	0.210	2.005	0.610	3.750

Growth performance in relation to Competition:

The maximum root length was 8.5 ± 0.2 cms. in C3 and in C1 and C2 the roots measured 7.5 ± 0.2 cms. and 8.0 ± 0.5 cms. respectively. On the contrary shoot attained maximum length (25.5 ± 3.0 cms.) in C1, and in C2 and C3 it was 21.3 ± 2.5 cms. and 18.2 ± 2.3 cms. respectively. In all the three sets the plants produced 4 primary and 8 secondary branches. The length of primary branch was 7.5 cms, 9.6 cms. and 8.5 cms. in C1, C2 and C3 and that of secondary branch 5.3 cms, 4.2 cms and 4.5 cms. in C1, C2 and C3 sets respectively.

The area of radical leaves did not vary much: being $25.2 \text{ cm}^2 \pm 2.0$ cm. in C1 and $20.6 \text{ cm}^2 \pm 2.2$ cm. in C2 and in C3. The area of cauline leaves was almost the same: In C1 $20.8 \text{ cm}^2 \pm 1.8$, in C2 $20.6 \text{ cm}^2 \pm 1.5$ and in C3 $21.2 \text{ cm}^2 \pm 1.8$.

The maximum number of leaves/plant were in C2 (28), 20 in C3 and 24 in C1. Great variation in the number of flowers was observed in C1 (12). However in C2, and C3 it was 8 and 4 respectively in C3.

But the diameter of flowers did not vary being 1.0 cms. in all the sets. The total number of fruits was 10, 8 and 6 in C1, C2 and C3 respectively. The seeds were in the number 50, 40 and 30 in C1, C2 and C3 respectively. On an average (100 per set) seeds weighed

Table 18. Growth performance of *Geranium nepalense* in relation to Weed competition.

Site	Root length cms	Shoot length cms	Branches Pri. cms Sec. cms	Length of branches Pri. Sec.	Leaf area Radical cms ² Gauline cm ²	Average leaf No./plant	No. of flowers per plant	Dia. of flowers	No. of fruit per plant	No. of seeds per plant	Average seed wt gms	Dry wt. root gms	Dry wt. shoot gms	Fresh wt. root gms	Fresh wt shoot gms
G ₁	7.5 ±0.2	25.5 ±3.0	4 8	7.5 5.3	25.2 ±2.0 20.8 ±1.8	24	12	1.0	10	50	0.065	0.310	1.150	0.955	2.110
G ₂	8.0 ±0.5	21.3 ±2.5	4 8	9.6 4.2	27.9 ±2.5 20.6 ±1.5	28	8	1.0	8	40	0.065	0.210	0.750	0.575	1.250
G ₃	8.5 ±0.5	18.2 ±2.3	4 8	8.5 4.5	26.0 ±2.2 21.2 ±1.8	20	4	1.0	6	30	0.065	0.210	0.950	0.650	1.525

0.065 gms. from all the three sets. The fresh weight of the root and the shoot was in C1. The root weighed 0.955 gms. and the shoot 2.110 gms. In C2 these weighed 0.575 gms. and 1.250 gms. respectively (minimum), whereas in C3 it was 0.650 gms. and 1.525 gms. respectively. Accordingly the dry weight of root was maximum in C1 (0.310 gms) and minimum in C2 and C3 set (0.210 gms); and the dry weight of shoot in C1 was maximum 1.150 gms. and minimum in C2 (0.750 gms.). In C3 the dry weight of shoot was 0.950 gms. (Table 18).

Growth performance in relation to soil texture:

The plants were grown in polythene bags using different types of soils viz. Garden soil, Karewa soil, Garden soil + sand, orchard and paddy soil to study the growth performance of *G. Nepalense* in relation to different soil textures. The bags were accordingly labelled as Gnep T1, T2, T3, T4 and T5.

The roots attained maximum length (10.2 ± 0.5 cms) in T4, and minimum in T2 (set 5.0 ± 0.6 cms set); in T1 being 9.9 ± 0.5 cms in T3 and T5 7.9 ± 0.2 cms and 5.7 ± 0.2 cms. respectively. The maximum length (29.7 ± 2.5 cms) attained by the shoot was in T1 set; and it was 27.8 ± 1.2 cms in T4, in T2, T3 and T5 set being 14.7 ± 1.8 cms, 22.3 ± 1.5 cms and 10.5 ± 1.5 cms respectively.

The number of primary branches was only 2 in T2, T3 and T5 and 4 in T1 and T4 and that of secondary branches was 4 in T2, and T3 and T5 and 8 in T1 and T4.

The length of primary as well as secondary branch was maximum in T1, 12.2 cms. (primary) and 7.4 cms. (secondary). In T5, 4.2 cms in primary and 3.0 cms in (secondary). In T4, 10.5 cm (primary) and 7.0 cms, (secondary). However, in T2 and T3 it was 8.0 cms. and 6.3 cms. (primary) and 3.7 cms. and 4.0 cms. (secondary).

The varied soil texture seemed to have a direct impact on the area of radical leaves which ranged between $17.60 \pm 1.0 \text{ cm}^2$ (T4 set) and 24.02 ± 2.2 . In T2 the area of leaves was $22.23 \pm 2.0 \text{ cm}^2$ in T3 and in T5 it was $19.25 \pm 1.8 \text{ cm}^2$.

The area of cauline leaves ranged between $12.15 \pm 0.8 \text{ cm}^2$ (T2) to $21.45 \pm 1.2 \text{ cm}^2$ in (T4). On an average the maximum number of leaves were in T4 (26), and 10 in T2, T3 and T5.

The plants did not produce many flowers except in T1 and T4 (12 and 8 respectively). In T2 and T3 being 6 and in T5 only 4. However the diameter was rather uniform 1.0 cm in all the plants.

The number of fruits produced by the plants in T1 was 12 and 10 in T4 and 2 and 6 in T2, T3 and T5

respectively. The total number of seeds was 60 in T1, 10 in T2, 30 in T3, 50 in T4 and 20 in T5. On an average the seeds weighed 0.065 gms. in T1, T3 and T4 and 0.058 gms. and 0.060 gms. respectively in T2 and T5.

The dry weight of root was 0.420 gms. in T4 (maximum) and 0.60 gms. in T5 (minimum). In T1, T2, and T3 fresh wt. of root was 0.225 gms, 0.090 gms, and 0.100 gms. respectively.

The dry weight of shoot was maximum in T4 (0.910 gms) and minimum in T5 (0.175 gms). In other three sets it was 0.755 gms. in T1 and 0.210 gms in T2 and T3. Accordingly roots recorded maximum fresh weight in T4 (1.190 gms) and minimum fresh weight (0.125 gms) in T3. The fresh weight of shoot in these sets was 4.275 gms (T4 set) and 2.000 gms (T3 set). In T1 set the fresh weight of shoot was 3.755 gms. In T2 and T5 the fresh weight of shoot was 2.225 gms. and 2.005 gms. respectively (Table 19; Plate 9-11).

Table 19. Growth performance of *Geranium nepalense* in relation to soil texture.

Site	Root length cms	Shoot length cms	Branches Pri. Sec. cms cms		Length of branches Pri. Sec. cms cms		Leaf area Radical Cauline cms ² cms ²		Av. leaf No./plant	No. of flowers per plant	Dia. of flowers per plant	No. of fruit per plant	No. of seeds per plant	Av. seed wt gms	Dry wt. root gms	Dry wt. shoot gms	Fresh wt. root gms	Fresh wt shoot gms
T ₁	9.9 ±0.5	29.7 ±2.5	4	8	12.2	7.4	24.0 ±2.2	19.95 ±1.5	20	12	1.0	12	60	0.065	0.225	0.755	0.475	3.755
T ₂	5.0 ±0.6	14.7 ±1.8	2	4	8.0	3.7	22.2 ±2.0	12.1 ±0.8	10	6	1.0	2	10	0.058	0.090	0.210	0.190	2.225
T ₃	7.9 ±0.2	22.3 ±1.5	2	4	6.3	4.0	19.2 ±1.8	13.4 ±0.8	10	6	1.0	6	30	0.065	0.100	0.210	0.125	2.000
T ₄	10.2 ±0.5	27.8 ±1.2	4	8	10.5	7.0	17.6 ±1.5	21.4 ±1.2	26	8	1.0	10	50	0.065	0.420	0.910	1.190	4.275
T ₅	5.7 ±0.2	10.5 ±1.5	2	4	4.2	3.0	19.2 ±1.8	17.6 ±1.8	10	4	1.0	4	20	0.060	0.060	0.175	0.145	2.005

Plate 9 - Growth performance of *Geranium nepalense*
in relation to
a - Varying irrigation practices
b - Varying lights.



a



b

Plate 9

Plate 10 - Growth performance of *Geranium nepalense*
in relation to
a - Organic manure
b - Weed competition.



Plate 10

Plate 11 - Growth performance of *Geranium nepalense*
in relation to varying soil texture.



Plate 11