DISCUSSION

The ecological life history study of *Euphorbia helioscopia* L. was undertaken to find the possible reasons for the wide distribution of the plant species in the valley of Kashmir, situated at the latitude of 32°-35° North west and longitude of 73° east and with an average altitude of 1500 m above mean sea level, where it has become a troublesome weed. The importance of such studies has been emphasised recently by Tansley (1949), Penfound (1952) and Pelton (1953), as according to these authors such studies help in understanding the distributional pattern of plants which in turn greatly helps in solving the biological problems connected with environmental responses, adaptation and speciation. Since the plant species under reference is also an obnoxious weed the study of its ecological life cycle becomes all the more important, as Brenchley (1915) has strongly advocated the need for life cycle study in order to achieve a successful eradication of a weed.

Observations conducted at a number of sites revealed the species as capable of growth on diverse habitats during different seasonal conditions round the year. This pattern of wide distribution on diverse substrate types suggests that the plant species is capable of developing the requisite qualities for growth in every situation. However, the soil constituents do seem to affect the overall growth performance of the plant species.
The maximum values for the growth indices employed, were obtained for the sites rich in organic matter and on the soils that contained comparatively higher proportion of sand in combination with clay and silt (cf. Table 7). Such soils were found to be moisture retentive, well aerated and favoured a better growth and spread of roots thereby helping a continuous and better supply of nutrients to the shoots that showed a luxuriant growth. The results were confirmed by growth under cultural conditions as well. The plants growing on loamy soils attained maximum growth (cf. Table 10) while, they showed comparatively poor growth on sandy soils mainly because of the lack of moisture and nutrients.

The plant species was observed growing on soils with varied moisture content ranging from wet to dry, the growth being more luxuriant on moderately moist soils (cf. Table 9a). The plants growing on such soils showed a better growth performance in terms of fresh and dry weight of the shoot (2.572 gm and 0.669 gm respectively) and the length of the root 17.5 cm and the shoot 26.9 cm (cf. Table 10). A significant correlation was observed between the root development and penetration and the available moisture in the soil (Figure 45). The roots excavated from sites with low moisture due to a receding water table showed greater linear and lateral dimensions both for the main tap root as well as the laterals. In soils with high degree of moisture retentivity (upto 29.8%), the roots, on the other hand, were linearly elongated but the laterals were tufted together in the upper regions.

Growth of the plants under controlled irrigation levels supported the field observations in as much as the
plants were capable of growth on wet as also on the dry soils. However, the growth declined under increased intervals between two successive irrigation periods or when the soils were inundated with water for longer duration (c.f. table 15). Frequent irrigation at short intervals enhanced the vegetative as also the reproductive growth of the plants.

E. helioscopa, was observed growing on soils that showed variation in calcium content and pH value. This suggests that the species has a wide range of tolerance for soil calcium and is capable of growing both on calcium rich as also calcium poor soils (c.f. table 11). However, a higher calcium content in the soil invariably resulted in the decrease of the dry matter accumulation during preflowering or fruiting period. The plant was observed to absorb more calcium from calcium rich soils as is evident from the high content of calcium in the foliage (c.f. table 11 a, b), at sites I. and IV.

Plants raised on soil with varied levels of lime content confirmed these observations gathered from the field. The plants were stunted, with leaves showing distinct signs of chlorosis, when grown in soils with highest average calcium content (upto 27.96 %). Growth in terms of shoot length and dry matter production was highest in soils with minimum available calcium (upto 0.231 %). The total calcium accumulated in the plants increased with increase in the soil calcium (c.f. table 14). A similar behaviour was observed by Ramakrishnan and Singh (1966) in Cypodon dactylon. Clarkson (1967) observed that Agrostis setacea showed a better growth performance in calcium poor soils, while A. stolonifera showed signs of calcium deficiency in the same soil although the total calcium accumulated in the
Figure 43. Graph showing correlation between soil moisture and growth performance of *S. helioscopia* plants as observed in nature.

Figure 44. Graph showing correlation between the growth performance of *S. helioscopia* plants and C/N ratio of the soils (a) cow dung (b) horse dung.
Fig.: Root and shoot growth in relation to soil moisture.

Fig.: % Nitrogen in plants and soil across different sets.

- Root
- Shoot

% Soil Moisture vs. Length in cm.

Sets vs. % Nitrogen.

Sets I, II, III.
two plants was the same. Cooper (1943) had also observed that the legumes were able to absorb more calcium and magnesium from calcium rich soils. Goodall and Gregory (1947) suggested that under extreme deficiency or very high levels of nutrients in the soil, there may be observed many a marked differences in the mineral nutrient composition of the plants. Even though we now know that *E. helioscopia* is capable of growth on calcium rich as also the calcium poor soils yet it can not be pinpointed as to whether this single factor is determinative in controlling the inherent growth rate and distribution of the plant species in nature as using of a single factor for controlling the growth rate and distribution has many limitations. Clarkson (1969) has suggested that the evolution of nutrient poor situations has involved the selection of those individuals that make a low rate demand on the nutrient supplying mechanism of the system. And it is probably this property that explains the cause for the wide range of tolerance developed by the plant species to fit in the various edaphic situations. Correlations between the exchangeable ions in the soil and the mineral composition of plants have been drawn by Mall (1955), Pandeya (1955), Joshi (1959), Ramakrishnan (1959) and Wakhloo (1961).

Higher organic matter content of the soil had a profound influence on the growth of the plant species, mainly because of the higher available nitrogen content in such soils. With an increase in the soil organic matter content from 0.360% to 3.28% there was a consequent increase in the dry weight of the plant from 1.785 gm to 6.904 gm (c.f. table 12). It is for this very reason that the plant exhibits luxuriant growth on heaps of debris, dung, manure and dirt in nature. Misra et al. (1963) also observed the growth
and distribution of *Peristrophe bicalyculata* in Banaras to be synchronized with physiological adaptation of nitrogen absorption and assimilation as affected by light. The increase in growth due to high levels of organic matter or/and nitrogen in the soil has been reported in case of *Lupinus texansis*, *Foa alpina*, *Artemesia* sp, *Festuca ovina* and *Potentilla* sp by Koch (1961), Scott and Billings (1964), Elinberg (1964), Johnson (1964) and Nixon (1964) respectively.

Under cultural conditions the growth of the plants was enhanced in soils treated with different proportions of horse dung powder, while the growth decreased under increased quantity of cow-dung powder. Although the percent organic matter content and the nitrogen content in the soils treated with horse-or cow dung was not significantly different, yet the plants grown in soil treated with horse - dung powder grew better and absorbed more nitrogen (c.f., Fig. 44 table 16 a, b). It is precisely because the C/N ratio of the cow -dung treated soil is far higher than that of horse -dung treated soil. The higher C/N ratio has been observed to cause the immobilisation of nitrogen in the soil for first 4 to 8 weeks of growth (Tisdale and Nelson, 1964) and hence almost no nitrogen is made available to the plants during this period which results in the diminution of growth.

It was observed in soils treated with fertilizers that both the vegetative and reproductive growth was more luxuriant in soils containing highest dosage of potassium and phosphorus. Such soils favoured a higher percentage ash content (upto 17.20 percent) as compared to soils with low proportion of potassium and phosphorus. However, a higher content of nitrogen alone did not favour the growth of the
plants. Thus, it can be inferred that in addition to nitrogen, higher levels of potassium and phosphorus are also needed for better growth of the plants. Higher levels of potassium and phosphorus in combination, or either of them alone, however, helped in improving the shoot length, higher ash content and higher mineral absorption in the plants (c.f. table 18).

*B. helioscoopia* evidently shows a wide range of tolerance for the various edaphic constituents and is capable of growth on any type of soil. Moreover, the plant species is able to produce viable seeds of the same size and weight, irrespective of the extent of vegetative growth on soil media that differ in physical and chemical composition. This explains the cause for its occurrence as a weed in most of the parts of the world on the soils that are normally unconducive for the establishment and perpetuation of other plant species.

Further, observations in the field revealed the plant species as capable of growth both in open and partly shaded situations. The growth, however, is more profuse at the sites exposed to sunlight for only a part of the day while the plants fail to reproduce under complete shade (c.f. table 23). The dry matter accumulation by the plants was highest at partly exposed habitats. This differential behaviour of *B. helioscoopia* towards light suggests the reason for its total absence from thick forest canopies where the species fails to survive due to lack of sunlight.

Pearson (1930) while trying to determine the relative effect of light and moisture on the growth of the plant species concluded that increasing soil moisture was effective in controlling the survival in quantity and that
at low light intensities all species were weak and would not survive in large numbers. Under cultural conditions the germination of the preserved seeds in *E. helioscopia* was observed to be indifferent towards both the intensity and the duration of the light period, yet the survival and establishment of the seedlings was very much dependent on the light factor (c.f. table 25). Shirley (1929) observed a steady increase in the weight of the pine seedlings with increase in the light intensity, the gain being in direct proportion up to 40% of full light. A similar initial increase in the weight of *E. helioscopia* seedlings was observed (c.f. table 26) when the exposure to sunlight was increased from 3 to 8 hours. The values, however, decreased under longer durations of exposure to sunlight with minimum accumulation of dry matter (0.266 gm and 0.193 gm in 'summer' and 'winter' forms respectively) obtained under 12 hours exposure to sunlight.

Contradictory reports exist in literature regarding the increase in dry weight of the plants with increase in the duration of the light period. Welch (1966) observed that *Juncus squarrosus* plants could establish better with reduction in shading while Sharma and Sen (1969) observed an increase in the dry matter production under increased light conditions in various species of Solanaceae when the weight decreased under dark conditions.

The phenological observations at different sites in the field revealed the existence of two morphological forms within the plant species growing in different seasons of the year. The two forms showed some characteristic differences in their growth behaviour in the field. Since the two forms exist in two different seasons of the year
they are designated as the 'summer' and the 'winter' form. The 'summer' form is encountered during March - July, while the 'winter' form grows from November to May. Both the forms are best adapted to their respective ecological conditions and the key to their successful establishment lies in high pollen viability (85% in 'summer' form and 92% in the 'winter' form), high seed set (512 and 1702 seeds per plant) in 'summer' and 'winter' forms and a large colonizing potential.

The morphological differences exhibited by the two forms under natural conditions are confined to the vegetative phase of the plants. The 'winter' form appearing in late October gets a longer and competition-free time-gap for better vegetative growth as most of the species disappear from the various sites by the time this form appears. It grows vegetatively till the onset of winter when the erect shoots tend to become prostrate and develop the characteristic red pigmentation under the influence of low temperatures. In March, the shoots again grow erect and flower. The 'summer' form starts growth from last week of February and flowers by mid March with the result that the extent of the vegetative phase is limited. It is primarily because of this feature that the 'winter' form plants generally show better shoot length, root length, leaf number and leaf dimensions as also the seed output in addition to fresh and dry weight than the 'summer' form plants.

The differences in the physiological requirements of the seeds (because of germination and establishment in two different seasons of the year), as also the growth behaviour of the plant species that lead to the recognition of the two seasonal morphological forms in *E. helioscopia*
seem largely to be controlled by the temperature factor. Such seasonal or climatic races or varieties have already been reported in *Nicotiana tobaccum* (Camus and Went 1952), *Poa sp* (Heisey 1953) and *Xanthium strumarium* (Kaul 1959), 65, 67, 71. Heisey (1953) observed different responses to different day and night temperatures in *Achelis borealis*, which appeared to be linked with the seasonal temperature cycles of natural habitat. Went (1957) correlated the differentiation of 'winter' and 'summer' forms in certain desert plants with seasonal temperature and rainfall.

Under cultural conditions most of the differentiating characters between the two seasonal forms, encountered in the plant species become less prominent when the seedlings of both the forms are grown under similar light and temperature conditions from March to July. The differences however, are somewhat highly prominent in out of season growths. It is precisely, for the same reason that the 'summer' form fails to grow erect if raised during 'winter'. The plants in such sowings assume prostrate habit so characteristic of the 'winter' form. Similarly, the differences with regard to seed output, shoot length and dry matter production between the plants of two forms become prominent only when they are raised together during the summer or autumn months (c.f. table 20).

*E. helioscopia* fails to flower and reproduce under photoperiods of less than 8 hours or more than 14 hours duration under cultural conditions. In nature the plants remain vegetative and do not take to flowering during December to February in Srinagar, while the plants growing at Jammu and Ramban are observed in the flowering and fruiting conditions during this period. The very fact
Figure 45. Photograph showing *S. helioscopia* plants growing against a wall in vegetative phase during winter months at Srinagar.

Figure 46. Photograph showing dense stands of *S. helioscopia* (winter form) plants at University Campus in early March.

Figure 47. Photograph showing isolated winter-form plants during early March.

Figure 48. Photograph showing *S. helioscopia* plants in flowering phase at Jammu during January month.
that the seed germination in the plant species is indifferent towards light intensity and duration as also the fact that the two forms of the plant species take to reproduction and flowering under 12 to 14 hours day length in March to April months under natural conditions suggests that the plant is an intermediate flowering form and the differentiation in the forms is least caused by the photoperiod. Further support to this assumption is lent by the flowering behaviour of the plant species between December and March. Even though the light period operating at Jammu and Srinagar during the period is hardly different (Figure 45-49), yet the plants flower in Jammu and remain vegetative in Srinagar. It therefore, shows that the flowering process in the plant species is conditioned by the temperature factor of the climate.

Davidson (1965) observed that flowering in *Froelichia floreadiana* was rapid under 9 hour photoperiod, and decreased under increased photoperiods at California in the southern as also the northern forms of the plant species. On the other hand, Olmstead (1945) contends that different plant species differ in their photoperiodic requirements at different latitudes. McNaughton (1964) observed different photoperiodic responses in the latitudinal races of *Typha latifolia*. In this plant species, the northern forms became dormant under lower temperatures coupled with short photoperiods while the southern races remained active through a wide temperature and photoperiodic range.

*B. helioscopia* remains vegetative under extremely low temperatures and short photoperiods of winter in Srinagar, while the prevalence of slightly higher temperatures
at Jammu induces the plants to flower, (Appendix I).

The stomatal index values are higher (c/f. table 29) on the lower leaf surface as compared to the upper, the average values on both the surfaces being higher under partly shaded habitats in both the forms. Walker and Dunn (1967) observed differences in the stomatal frequency, stomatal size and epidermal cell frequency in the leaves of Alaskan pea. Highest values for stomatal and epidermal cell frequency were observed by these authors in leaves collected from plants growing in xeric conditions. Stomatal frequency is not consistent in case of B. helioscopia, and the differences observed under different light conditions are not very prominent. These observations, therefore, are not of much help in estimating the effect of environmental factors on the plant species. Similar tendency was observed by Sharma and Dunn (1966) in Datura sp. in relation to its epidermal features which were not trustworthy. The authors, however, obtained a higher trichome frequency on the lower surface of the leaf than on its upper surface, the frequency being higher under open and xeric conditions. Similar results were obtained with the leaves of B. helioscopia, the trichome density was higher on the lower surface of the leaf under open light conditions (c/f. table 31) and the values came down under partly shaded and completely shaded habitats in both the forms.

Evidently, the differences observed with regard to habit, shoot length, seed output, reproductive and the aggressive capacity in the two forms of B. helioscopia do not seem to be very much rigid and appear to be mainly induced by the fluctuating temperatures during the different seasons in nature. The little differences retained
even under cultural growth under similar set up of environmental conditions seem to have mainly arisen because of the germination of the seed of the two forms in two different seasons of the year. The studies conducted on physiology of the seed would further support this conclusion.

The seeds of the two forms collected from tagged plants in nature hardly show any difference in shape, size and colour yet, the summer form seeds have a lower average fresh and dry weight as compared to the winter form seeds. Consequently the winter form seeds retain a higher moisture content than the summer form seeds. The freshly harvested seeds of the two forms show a definite requirement for low temperature (in summer form) and a higher temperature (in the winter form) in nature and it is precisely for the same reason that the summer form seeds germinate between late February and March following first few showers received immediately after the snow cover has melted away at temperature range of 6° C to 12° C. The seeds of the winter form germinate during October to November at the expense of the late autumn showers within temperature range of 15° to 20° C.

The dormancy of the seeds that lasts from 6 to 8 months in nature can be overcome by treating the seeds with low concentrations of acetic acid or a hot water wash. This suggests that the seed coat carries some sort of inhibitor within itself that loses its effect with the passage of time in nature, or is washed away along with the leachates in the soil. Removal of the seed coat in fresh seeds or prechilling at early stages for short intervals also helps in overcoming the dormancy of the seeds.
Seeds of both the forms show a high percentage viability on storage under laboratory conditions and the viability increases with increase in the duration of storage. The seeds, however, are thrown into a secondary state of dormancy if stored for more than 24 weeks at a constantly high or low temperature and this can be overcome by exposing the seeds to subfreezing temperatures for brief periods.

The seeds of both the forms are capable of germination within pH 5.0 to 9.5 with maximum values obtained at pH 7. This explains the cause for its total absence from forest or coastal areas. Moderate supply of moisture upto 25% in the soil, favours better germination of the seeds which normally fail to germinate in water-logged or moisture deficit soils.

Laboratory investigations revealed that the germination values increase with increase in the temperature under dark in both the forms though highest values are obtained at 20°C in the 'summer' form and at 30°C in the 'winter' form. This suggests that the seeds of the two forms have different and definite optimum temperatures required for germination to set in. Further the 'winter' form seeds fail to germinate at 0°C in dark and can be induced to germinate only after exposure to light for nearly eight hours.

The seeds shed off the plants during June and July months are subjected to the effect of high summer temperature followed by constant drought and this feature throws the seeds into a secondary state of dormancy (in the 'summer' form) which loses its effect only after the exposure to below 0°C temperature during December to January, and favours germination in the 'winter' form seeds (due to high temperature effect) during late October and November months.
Germination is favoured by alternating temperatures from 5° C to 20° C in the 'summer' form and 0° C to 10° C in the 'winter' form. This suggests that seeds of *E. helioscopa* have a definite temperature requirement for germination to set in and these optima for the two forms are best met within the early spring and late autumn seasons in nature.

The results obtained and discussed above would tend to indicate that the dormancy due to seed coat enhances the adaptability of the seeds to its normal environs. The alternating fluctuations of low and high temperatures, both diurnal and seasonal, as also the availability of water just after the hot dry months in October and low freezing cold in March, in the form of rain brings about imbibition and germination of the seeds in nature under the required temperature ranges in the two forms. It is this feature that induces the seeds of the two forms to germinate at two different periods not related to each other.

The 'winter' form has a higher colonizing potential than the 'summer' form and this can be attributed to higher seed set and lesser rate of seedlings mortality. The combination of usually prompt and complete germination with high rate of seedlings establishment coupled with fast rate of root and shoot growth for survival and quick colonization give an added advantage to *E. helioscopa* over the other plants in their respective seasons of growth.

Both the forms occur as dominants at the respective sites of occurrence during their initial phases of growth recording the highest importance values (c.f. table ) at the various sites. This high importance of the plant species can be attributed to its early growth as the
plant species is fully established by the time other plants appear at the various sites and consequently it leads a competition free life for most of the time. In addition, due to the presence of the acrid juice the plants are not grazed by the cattle, nor are they frequently clipped or mowed. These features also help the species to grow as a leading dominant at the various sites.

Such observations have a great significance when correlations are drawn between a plant species and its varieties, or forms and ecological and geographical distribution. Thus, from the studies conducted, it can easily be inferred that even though the plant species is capable of growth on any type of soil, yet its distribution in Afghanistan, Persia, Iraq, Europe, Mediterranean, United States, West Asia, Japan and north-west India is conditioned by climatic factors. Its reported occurrence in these places and continued absence in other parts of the world is mainly because the plant species has been reported growing only at such of the places in the above mentioned list that share similar climatic conditions (Kendrew), that is, low minimum January temperature accompanied by rain and snow, followed in turn by high temperatures during July and August.

The occurrence of the plant species on the diverse habitats in the Kashmir Valley indicates the adaptability of the plant species to varied ecological niches. Its continued absence in various parts of India and other parts of the world that share a different set of climatic conditions lends further support to our assumption regarding the climatic barrier in the distributional pattern.
Similarity with regard to the chromosome number $6n=42$ ($n=7$), process of meiosis and pollen viability $85\%$ and $92\%$ (Fig) of the 'summer' and 'winter' forms of *E. helioscopia* indicates that they have originated from a single stock and show certain temporary differences in their morphology under the influence of different seasonal temperatures in the Valley of Kashmir. These differences are however, not retained if the plants are grown under similar seasonal conditions.
**SUMMARY**

*Euphorbia helioscopia* L., (sun spurge) is an annual of cosmopolitan distribution in tropical, sub-tropical and temperate regions of the world. In India, the plant species occurs all along the north western Himalayas including Jammu and Kashmir. In the Valley of Kashmir, it is a serious weed of the croplands.

The wide spread distribution of this plant species is chiefly due to its adaptability to occupy diverse substrate types which vary in their mechanical and chemical composition.

The plant species is capable of growth both on calcium rich and calcium poor soils, showing a wide range of tolerance for soil calcium. The plants are capable of absorbing more calcium from calcium rich media. Higher organic matter content favours better and luxurient growth of the plant species.

The plant has a wide range of tolerance for available soil moisture and is capable of growth on wet as also on dry soils. Growth, however, is more pronounced on soils that are irrigated at short intervals, while the plants growing on dry or constantly inundated soils are stunted.

A higher sand content in the substratum helps in better growth of the plant species.

In nature the plant exhibits two seasonal forms in Kashmir viz., the 'summer' form that shows optimum activity from March to July and the 'winter' form that
shows optimum activity during November to May.

The 'winter' form of *R. helioscopia* remains vegetative till March. During December to February, the shoots grow prostrate, lose most of the leaves and develop the red pigmentation under the influence of subfreezing temperatures. The prostrate shoots get erect during March and take to flowering along with the 'summer' form.

In nature, the longer shoot and root, higher leaf number per plant, leaf dimensions and the high seed output in the 'winter' form besides its growth during winter months is the only feature that separates it from the 'summer' form. The differences, however, become less prominent when both the forms are cultivated under identical edaphic and seasonal conditions during Spring and Winter months. The differences, however, come to light during out of season growth in summer and autumn months.

The plant species occurs in open and partly shaded habitats. Growth is luxuriant if the plants receive sunlight for only a part of the day and the plants fail to attain reproductive maturity under complete shade.

Under natural conditions the plant species shows peak flowering during March to April (under 12-14 hours day length) and is thus an Intermediate flowering plant. The plants fail to reproduce at photoperiods of less than 8 hours or more than 16 hours, duration under cultural growth.

*E. helioscopia* reproduces only through the agency of the seeds, and the seeds lack all the possible mechanism that could favour dispersal. Carriage by man through mud, straw and soil is the only way for seed dispersal in addition to the limited dispersal brought
about by wind, rainwater, or ants.

The cyathial structure is best adapted for insect pollination and the presence of glands helps to attract butter flies, bees, ants, flies, etc., to the plants thus favouring cross pollination.

Seeds of *E. helioscopia* show the characteristic dormancy period lasting for 6 to 8 months. The dormancy is mainly because of the resistance offered by the seed coat or else due to the immature embryo which can be overcome by treating the seeds with acetic acid, pin-pricking the testa, or by low temperature stratification for brief periods.

The seeds remain viable even after storage for 24 months under natural conditions and the germination improves after storage for more than 3 months.

Seeds stored at constant temperatures of 0°C, 10°C, 20°C and 30°C for more than 24 weeks are thrown into a secondary state of dormancy which can again be overcome by treatment with low sub-freezing temperatures for brief periods.

Seeds are capable of imbibing moisture at low (5°C) as also high (25°C) temperatures though imbibition rate is enhanced with increase in the temperature. A higher concentration of the salts in the medium checks the imbibition rate of the seeds.

Seeds fail to germinate at pH of less than 5 or more than 10, and that explains the cause for its absence from coastal areas. The germination is hindered if the seeds are buried deep in the soil. Maximum seeds germinate at 25% soil moisture levels, while the seeds fail to germinate in water logged soils or else if the soils are maintained dry for a considerably long period.
Germination in preserved seeds is indifferent to light though seedling mortality is higher under lower intensities. The red light promotes the germination of the seeds while the blue and the far-red exposures prove inhibitory.

In *E. helioscopia*, the 'summer' form seeds show maximum germination at low temperature ranges while the 'winter' form seeds can be induced to germinate at low temperatures only in the presence of light. The 'summer' form seeds show brisk germination between alternate temperature of 0°C to 10°C while the 'winter' form seeds show maximum germination between 5°C to 25°C alternate temperature.

Seeds fail to germinate if soaked in concentrations higher than 300 ppm of Gibberelic acid or 400 ppm of Indole-acetic-acid.

The plant species occurs as a leading dominant at the respective sites of occurrence during the seasons of its growth, because in the Initial phase there are very few plants to compete with it. Even during peak period of growth it retains dominance at most of the sites because it is exposed to minimum biotic pressures due to the presence of acrid latex. It is neither grazed by animals, nor mowed for fodder.

*E. helioscopia*, is a hexaploid (6n=42), n=7 showing regular meiosis and high pollen viability. The diploid and the tetraploid have not been reported occurring in the plant species.

High seed set, seed viability and large colonizing potential of *E. helioscopia*, are responsible for its having such a wide distribution range in various regions of the world that share the same type of climate (low minimum January temperature followed by snow and high maximum July temperature) as that of Kashmir.
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