MORPHOLOGY; TAXONOMY; DISTRIBUTION; DISPERSAL.

MORPHOLOGY AND TAXONOMY:

The general morphology of *E. helioscopia* has already been described by various authors like Hooker (1894), Hutchinson (1929), Lawrence (1947), Lewis (1958), Abrams, Leroy (1964) and Rechinger (1964) etc. The accounts presented by these authors pertain to the populations from various parts of the world and show a great degree of similarity. However, during the course of the present investigations, differences in the morphological features were observed between the two seasonal forms of this plant species growing under natural conditions in Kashmir (Plate 1). A detailed account of the morphological characters of the two forms is enumerated here under: (Fig. 3a-b)

Table I: Morphological features of the two forms of *Euphorbia helioscopia* as observed under natural conditions of growth.

<table>
<thead>
<tr>
<th>S.No</th>
<th>'Summer' form</th>
<th>'Winter' form</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Root</td>
<td>A well developed root system.</td>
<td>Tap root, rather woody</td>
</tr>
<tr>
<td></td>
<td>9 to 15 cm long, with a number of laterals arising at various points, cylindrical.</td>
<td>15-25 cm long, with few thick and long laterals</td>
</tr>
<tr>
<td></td>
<td>2.3 cm in diameter.</td>
<td></td>
</tr>
</tbody>
</table>
2. **Stem**
Annual, erect, cylindrical with 2 or no branches at the base, glabrous, greenish brown 10-23 cm tall. Terminates hard 15 to 45 cm long upto into 5 rays at the top. Branch- es upto 17 cm long.

Annual, much branched from near the base, erect or semierect, bushy, cylindrical, 2 cm in diameter, hairy and greenish brown in colour. Branches upto 50 cm long.

3. **Leaf**
Alternate, obovate, sessile with a cuneate base, margin serrate 1.2/0.8 cm in length/breadth, single nerved. The floral or bract leaves are broader than the vegetative leaves, corresponding in number with the number of rays, obovate spatulate, 1.5/1.0 cm in length/breadth, subsessile.

Alternate, subsessile, oblong, obovate, serrate margin, hairy, single nerved 4.5/2.5 cm in length/breadth, greenish brown. Floral leaves sessile, obovate, spatulate, multi- nerved, 4.3/2.9 cm in length/breadth.

4. **Rays**
Five, subtended by the main shoot, terminal, arising in the axil of the bract leaf, from 0.5 to 2.9 cm long, further dividing into trichotomies once or twice.

Five, arising terminally on the main shoot and the branch, each ray 2.5 cm long hairy, thick dividing further into trichotomies.
5. **Inflorescence**

Polychasial cymose cyathia, terminal or axillary in position. The terminal cyathium arising on the main axis is represented by a cup like involucre, campanulate, formed of five bracts 2.4 mm long. The rim of the cup is bordered by five, reniform green yellow glands, 1 to 1.5 mm long, without horns, sterile. Axillary cyathia represented by involucral cups 4.5 mm long raised on a stalk 0.5 mm long, formed of 4 fused bracts, glands 4 oval, green, 1.5 mm long without horns.

6. **Male flower**

Represented by 16 to 20 stalked anthers arranged in four or five groups of 4 each. Stalk up to 2 mm long, anthers bilobed and dorsifixed.

7. **Female flowers**

Represented by a trigonous, orbicular smooth capsule, 2.3 mm long borne on a raised stalk, 1.2 mm long. Style 1 mm long, stigma trifid divided halfway.

Represented by a single capsule arising centrally on a stalk 5.7 mm long, capsule trigonous, smooth hairy 5 mm long, style trilobed 1 mm long, stigma trifid.
8. **Seed**

Ovoid, elliptical 2 mm long raised on one side, with a furrow on the opposite flat face. Seed coat hard, dark brown reticulately pitted. Oval, raised on one side and with a conspicuous ridge on the other, brownish black in color with a fine net work on the surface, 2 to 2.5 mm long, reticulately pitted.

9. **Pollen viability**

85 percent pollen are stainable. The pollen grains are rounded and triporate, smooth. 92 percent pollen are stainable. The pollen grains are rounded smooth to dentate and triporate.

10. **Chromosome number**

6n = 42. 6n = 42. (fig. 4, 5)

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**MORPHOLOGICAL ABNORMALITIES:**

To date, the literature available on *E. helioscopia* does not record any morphological abnormalities. During the course of the present investigations, however, some abnormal features in the plants growing under natural conditions, observed were:

1) The main shoot is deformed, entirely absent or attaining height of only 4 cm bearing few or no leaves, and terminating into a single cyathium without any rays. Branches arising at the base are stout and very well developed terminating in polychasial cymose inflorescences. Such plants usually occur along the side walls of deep channels with deficit soil moisture, on foot paths subjected to maximum biotic interference like trampling and grazing etc;

2) In some plants instead of the normal 5 rays at the terminal end of the shoot only 4 rays are produced. The fifth ray
is either entirely absent with deformed growth, or arising as an offshoot with one of the normal rays in the axil of its bract leaf.

**POLLINATION**

Due to the presence of glands on the rim of the cyathium, butter flies, caterpillars, ants, honey bees, flies and other insects frequently visit the plants during the flowering season. These visiting insects play a prominent role in transferring pollen from plant to plant and thus help in cross pollination. The structure of the cyathia and the arrangement of flowers also warrant the cross pollination in this species as is true for the genus as a whole.

**ETYMOLOGY**

The genus as also the family owes its name to the famous physician Euphorbus who was the personal physician of King Juba of Mauretania. He was the first man to have used the north African species of this genus for medicinal purposes. The species name 'helioscopia' is of Latin origin meaning movement towards sun. This is a characteristic feature in the plant species that under natural conditions of growth, the cyathium bearing head changes position with relation to sun light during the course of its East West movement in the day.

**SYNONYMS**

The few synonyms used for this plant species in the Index Kewensis are (Jackson 1875):

1. *Euphorbia haussknechtis*, Boiss
3. *Euphorbia japonica*.
5. *Euphorbia helioscopia*, Linn.
Locally the plant species is known by various names given to it either for its medicinal properties or on account of the latex found in the plant body. The most common names used in various regions of India are:

- **Dudal** .......Punjabi,
- **Gandha bhuti** ....Bengali,
- **Gur-sochal** .....Kashmiri,
- **Gur-gassa** .....Kashmiri,
- **Dada-gassa** ....Kashmiri.

**TAXONOMY**

The family Euphorbiaceae includes about 200 genera and more than 3000 species. Hooker (1854) has divided the family into six main tribes namely:

- a) Euphorbiae
- b) Buxeeae,
- c) Phyllanthae
- d) Galearieae
- e) Crotoneae and f) Hippomanaeae.

Euphorbiaceae was first adequately delimited as a natural group of plants by A.L. De Jussieu in 1789. The family is closely related to Geraniales in the structure of gynaecium although the reduction in flower size widely separates it from other dicot families. On account of the peculiar reduction in flower size, Euphorbiaceae and the Callitrichaceae are grouped together under a separate order Euphorbiales. This order is given a place between Polygalales and Sapindales with Geraniales proceeding it ( ). Pax and Hoffmann (1931) placed Euphorbiaceae and Daphniphyllaceae in the suborder Tricoccaeae of Geraniales, but recently Isao (1959) from Japan has separated these into two orders namely Euphorbiales and Daphnichyllales.

Nearly 600 species included in the genus Euphorbia, (Hooker, 1854) represented, by herbaceous or woody annuals and perennials, are all characterised by the presence of the cyathium inflorescence and milky juice (latex) in various plant parts.
Since the genus presents a heterogeneous assemblage of plants, Pax and Hoffmann (1931) divided it further into various homogenous sections. Small (1933) splitted it into six genera. Graizot (1944) considered it to represent a complex of forms that have been derived through differential specialization of a floriferous axis with three primary phyletic units as:

- E. helioscopia, 2n = 12, Nemmac (1910)
- E. helioscopia, 2n = 18, Harrison (1930)
- E. helioscopia, 2n = 42, Harrison (1930)

Cytologically as well the genus is very complex with a primary system of n equal to 8 and a secondary system of n equal to 6, 7, 9 and 10 (Darlington, 1956).

According to Perry (1942), about 40 percent of the species included in the genus are polyploids, although interaspecific polyploids are very rare. A survey of the chromosome numbers reveals both aneuploidy and polyploidy having been effective in speciation within the genus and the family as a whole (Perry, 1943).

**GEOGRAPHICAL DISTRIBUTION**

Euphorbia helioscopia, though a typical tropical species, shows cosmopolitan distribution (Fig. 2a, b) throughout the world (Hooker, 1854). A perusal of the existing literature shows it to be occurring commonly as a weed in fields, in Afghanistan, Persian foot hills, Jabelhamerin (Sutherland) jezire, Ash sharquat (Ashur), Lower Mesopotamia, Jadriyah, Baghdad, Karada, Khadamiya hillack (Rechinger 1964) Europe, Mediterranean, Pacific States, Washington, Oregon, California (Abrahms, Leroy 1962), West Asia, Punjab, Western Himalyas, Atlantic West and Japan, Jammu and Kashmir (Hooker, 1854) and West Africa (Perry, 1943).
Figure 1. Map showing the various soil types as found in the valley of Kashmir.

Figure 2. Map showing the geographical distribution of *Sphagnum helioscopium* in
a) various parts of the world
b) various parts of India
c) various parts of Kashmir,
Figure 3. a) 'Summer' form plant of *Euphorbia helioscopia*
b) 'Winter' form plant of *Euphorbia helioscopia*

Figure 4. Diagramatic representation of the various floral structures of *E. helioscopia*.

Figure 5. Cells with 31 bivalents at metaphase of meiosis in *E. helioscopia* (seasonal forms) showing the chromosome number = 42 (6n).
In India the genus is represented by about sixty three species (Hooker, 1354), including six species of doubtful occurrence. These species are reported distributed throughout the tropical, temperate, central and western Himalayas, Simla, Punjab, Kashmir, Jammu, Deccan, Madras, Rajasthan, Kumaon and Nepal, (Fig. 2b).

According to Hooker (1354) and Rao (1960), in Kashmir the genus is represented by six species namely:

1. *Euphorbia thymifolia*, Burm;
2. *Euphorbia wallichii*, Hooker;
3. *Euphorbia micractina*, Boiss;
4. *Euphorbia helioscopia*, Linn;
5. *Euphorbia prolifera*, Hamm;
6. *Euphorbia hispida*, Boiss;

During the field collection trips for the present investigation, however, two additional species viz., *Euphorbia pensa* L. and *Euphorbia cynarissias* L. have been recorded for the first time (Sapru and Kaul, 1970) from Kashmir.

In the State of Jammu and Kashmir *Euphorbia helioscopia* occurs as a common way side weed in cultivated and abandoned fields up to a height of 2100 m on the slopy surfaces of Tangmarg and Chandanwari. The plant species has been found growing in Jammu, Badharwah, Ramban, Sopore, Annantaag, Baramulla, Pampore, Ganderbal, Harwan, Shalimar, Srinagar, Phalgam and Kukurnag (Fig2.c).

**Dispersal**

Ridley (1956), in his treatise on mechanism and dispersal of plants, mentions, "In genus *Euphorbia* found all over the world, seeds are largely dispersed by man, carried in soil or grains, or mixed with other seeds. Some are conveyed in mud on the feet of birds or mammals. Seeds are also dispersed
by rain wash, a small number are undoubtedly sea dispersed. Small seeded Euphorbias seem to spread about the world very rapidly getting constantly to islands inspite of their want of special adaptation for dispersal.

Seeds of *E. helioscopia* lack all the special adaptations that help dispersal. From the plants the seeds are dispersed by the dehiscence of the capsule which breaks open along three ridges. The distance to which the seeds are thrown off as a result of capsule-rupture varies from plant to plant, (table 2).

Table 2. Seed dispersal in relation to plant height.

(Total seed set for 48 hours)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Plant height (cm)</th>
<th>Radial distance/Number of seeds dispersed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2cm</td>
</tr>
<tr>
<td>1.</td>
<td>5.0 cm</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>8.9 cm</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>10.2 cm</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>16.5 cm</td>
<td>5</td>
</tr>
<tr>
<td>5.</td>
<td>20.7 cm</td>
<td>6</td>
</tr>
<tr>
<td>6.</td>
<td>23.6 cm</td>
<td>6</td>
</tr>
<tr>
<td>7.</td>
<td>26.3 cm</td>
<td>4</td>
</tr>
<tr>
<td>8.</td>
<td>30.9 cm</td>
<td>8</td>
</tr>
<tr>
<td>9.</td>
<td>34.0 cm</td>
<td>10</td>
</tr>
<tr>
<td>10.</td>
<td>36.0 cm</td>
<td>8</td>
</tr>
</tbody>
</table>

Maximum number of seeds are dispersed within a radial distance of 8 to 20 cm from the plant. The height of the plant as also that of the capsule above the soil, however, play an important role in tossing off the seeds to farther distances from
the plant. With an increase in the height of the plant from 5 to 30 cm, the radial distance to which the maximum number of seeds are dispersed increases from 4 to 20 cm from the plant and the number of seeds dispersed ranges from 30 to 50 on an average (48 hours) at a distance of 16 cm radially. Thus from the foregoing account it can easily be inferred that the capsules raised high above the ground can disperse the seeds to farther distances from the plant than those lower down. It is obviously for the same reason that the plants with short stature occur in crowded patches under natural conditions of growth.

The dehiscence of the capsule seems to be influenced to a great extent by the light intensity, moisture content of the plant and the wind velocity.

In an attempt to study the effect of light intensity on the dehiscence of the capsules, plants that were growing in pots were exposed to different light conditions. The treatment was administered on plants bearing maximum number of mature capsules. The pots were placed on 1 sq. m sheets of paper and placed under different light conditions i.e., open sun light (in glass house), medium shade, (in the green house), deep shade (in a closed room) and artificial light of a bulb (inside laboratory). The number of seeds dropped on the paper in each case were counted at hourly intervals and the values set in table 3 give an average account for a twelve hourly period.

From the figures set in the table it appears that both the seasonal forms of the plant species show a similar response in regard to capsule dehiscence to varying light conditions. With an increase in the light intensity the number of capsules dehiscing per hour increased. Maximum capsules per hour, on an average, dehisced when the plants were placed in open, the values
Table 3. Capsule dehiscence in relation to light*

<table>
<thead>
<tr>
<th>S. No</th>
<th>Light conditions</th>
<th>Average number of capsules per plant</th>
<th>dehisced per hour*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Sun light SF</td>
<td>42 ± 3.5</td>
<td>21 ± 4.1</td>
</tr>
<tr>
<td></td>
<td>SF</td>
<td>65 ± 2.8</td>
<td>27 ± 3.9</td>
</tr>
<tr>
<td>2.</td>
<td>Medium shade SF</td>
<td>49 ± 3.1</td>
<td>19 ± 5.5</td>
</tr>
<tr>
<td></td>
<td>WF</td>
<td>72 ± 6.3</td>
<td>22 ± 2.8</td>
</tr>
<tr>
<td>3.</td>
<td>Deep shade SF</td>
<td>26 ± 2.9</td>
<td>5 ± 1.1</td>
</tr>
<tr>
<td></td>
<td>WF</td>
<td>32 ± 3.8</td>
<td>7 ± 3.2</td>
</tr>
<tr>
<td>4.</td>
<td>Bulb light SF</td>
<td>45 ± 5.2</td>
<td>21 ± 2.8</td>
</tr>
<tr>
<td></td>
<td>WF</td>
<td>62 ± 4.4</td>
<td>25 ± 3.7</td>
</tr>
</tbody>
</table>

(SF: summer form, WF: winter form)

* The effect of wind was eliminated by covering the pots with screens.

obtained for other situations being slightly lower. Under open light conditions 21 to 27 capsules dehisce per hour both in 'summer' and 'winter' form plants. Under partial shade and deep shade the number of capsules dehiscing per hour is low ranging from 19 to 20 on an average in partial shade and 5 to 7 capsules on an average in deep shade.

In order to evaluate the influence of wind velocity on capsule dehiscence, potted plants of the two seasonal forms of this species were placed at a distance of 2 meters from the electric fan, that was operated at three different speeds. The seeds dropped were collected on paper sheets, placed under the pots, and counted to obtain the exact number of dehisced capsules (table 4). An increase in wind velocity increased considerably the number of capsules dehiscing per hour, from a plant. Under
Table 4. Capsule dehiscence in relation to wind velocity

<table>
<thead>
<tr>
<th>S. No</th>
<th>Speed of the fan*</th>
<th>Average total number of capsules per plant</th>
<th>dehisced per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Fast SE</td>
<td>$49 \pm 2.3$</td>
<td>$25 \pm 1.3$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>WF</td>
<td>$73 \pm 5.4$</td>
<td>$36 \pm 4.1$</td>
</tr>
<tr>
<td>2.</td>
<td>Medium SE</td>
<td>$59 \pm 3.3$</td>
<td>$19 \pm 4.3$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>WF</td>
<td>$78 \pm 2.5$</td>
<td>$23 \pm 2.5$</td>
</tr>
<tr>
<td>3.</td>
<td>Slow SE</td>
<td>$51 \pm 2.6$</td>
<td>$12 \pm 2.4$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>WF</td>
<td>$68 \pm 3.3$</td>
<td>$18 \pm 3.1$</td>
</tr>
</tbody>
</table>

* An Usha Delux quality fan with three blades was used for the purpose.

** The experiment was conducted with potted plants in a closed room under normal light conditions. In all cases the pots were placed at a distance of 1 m from the fan.

Experimental conditions when the fan was operated at its maximum speed the number of capsules dehiscing per hour from ‘summer’ and ‘winter’ form plants ranged between 24 and 31 on an average.

Once the seeds are shed off the plants, rain, wind, animals soil transportation, ploughing and burrowing of fields by rats and rodents seem to help in carrying the seeds to considerable distance from the parent plants. Rains, subsequent to the seed formation result in the transport of the seeds along with moist mud by man and the animals as also the rain waters.

Under natural growth ants also seem to help its dispersal. A list of the number of ant holes visited in the campus area and the number of seeds procured from each hole.
### Table 5 a. Secondary dispersal by ants.

<table>
<thead>
<tr>
<th>S No</th>
<th>Locality</th>
<th>Total No of ant holes visited</th>
<th>No of seeds encountered</th>
<th>Average distance between 2 holes</th>
<th>Average total No of seeds</th>
<th>Average total distance between 2 holes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>University Campus (Cricket field)</td>
<td>37</td>
<td>4 ± 2.7</td>
<td>45.3 cm</td>
<td>11 ± 2.6</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Botanical garden</td>
<td>18</td>
<td>6 ± 2.9</td>
<td>55.2 cm</td>
<td>19 ± 5.0</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Dal lake Bank side</td>
<td>39</td>
<td>12 ± 1.2</td>
<td>51.9 cm</td>
<td>13 ± 2.8</td>
<td></td>
</tr>
</tbody>
</table>

### Table 5 b. Dispersal rate of the seeds as effected by ants.

<table>
<thead>
<tr>
<th>S No</th>
<th>Gradients of the heap</th>
<th>Total No per heap</th>
<th>Number of each gradient carried to the hole per hour</th>
<th>Average distance between the heap and hole</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Young capsules</td>
<td>50</td>
<td>11</td>
<td>40 cm</td>
</tr>
<tr>
<td>2.</td>
<td>Undehisced capsules</td>
<td>50</td>
<td>5</td>
<td>40 cm</td>
</tr>
<tr>
<td>3.</td>
<td>Dehisced capsules</td>
<td>50</td>
<td>23</td>
<td>40 cm</td>
</tr>
<tr>
<td>4.</td>
<td>Seeds with capsular sheath</td>
<td>50</td>
<td>31</td>
<td>40 cm</td>
</tr>
<tr>
<td>5.</td>
<td>Capsule sheath</td>
<td>50</td>
<td>39</td>
<td>40 cm</td>
</tr>
<tr>
<td>6.</td>
<td>Seeds</td>
<td>50</td>
<td>9</td>
<td>40 cm</td>
</tr>
</tbody>
</table>
as also the number of seeds observed on the ground between two
ant holes are computed in Table 5 a. These ants carry away the
seeds to eat away the oil body. This oil body according to
Sernander (1964) may be located on the seed, fruit wall, caruncle,
funicle or the base of the pericarp. This part of the seed that
carries the oil body is called as the "Elaiosome" (Sernander,
op. cit) and it forms the chief attraction for the ants. It makes
them to pick up the seeds from the soil and convey them to the
nest for licking the oil, leaving behind the uninjured seed.

In order to assess as to which part of the seed or
capsule is attractive to the ants, a simple experiment was
performed. Dehisced, undehisced capsules, seed wrapped in
capsular sheaths and those without sheaths were scattered at a
distance from an ant hole and later the exact number of each,
of these lots, carried to the hole were counted. The seeds with
intact capsular sheaths were carried in maximum number to the
ant holes, thus pointing to the fact that the oil body is
probably present in the capsular sheath (Table 5 b). This favours
the dispersal of the seeds to new and varied habitats as most
of the seeds and capsules are left scattered at various places
between the ant hole and the plant during transportation.

The transport of seeds by ants is not, of course, to
any great distance but it certainly adds a good deal to the
diffusion of the plant in the locality and it is probably of
considerable importance in the matter of dispersal along the
cracks in the profiles or walls. Although the ants crawl upon
the plants and flock in great numbers round the fruits, they
rarely or practically never gather the seeds from the plant.
Generally the seeds that are dropped to the ground are picked
up by them and this helps in the linear distribution of the
plants on the ground along the ant tracks.
Along the river and stream banks the seeds are carried away with the silt that is either washed away from the banks by the water currents or else removed by the locals for various construction purposes thus effecting the dispersal of the plants to new situations.

**ECONOMIC IMPORTANCE**

The plant is a wild weed and has become a menace for the agriculturists and the farmers in northern India.

Genus *Euphorbia* has been recognised as medicinally important ever since the royal Physician Euphorbus used the north African species of this genus for medical purposes. According to White et al. (1941) all the latex bearing plants of the genus have been used for medicinal purposes since 2500 years. The latex is a white poisonous gummy substance given the general name 'Euphorbon' as derived from *E. esula* (Muenchert 1940). According to him all spurges act as irritants, emetic and purgatives if taken internally. In cattle it causes scour and weakness, often resulting in death. The latex of *Euphorbia penulus* according to Schmaer (1955) contains small amounts of di- and tri-terpenes. Locally in Kashmir the plant is known as Zhar gassa (Sapru and Kaul 1969) or poison weed. It has been observed by locals of the valley to cause instantaneous death if grazed by cattle and normally the milky sap if applied to naked skin causes burns and irritation.

*Euphorbia helioscopia* is known as a common menacing weed to the farmers in northern parts of India. In addition the herb known locally as gandha bhuti or dudal has been recognised to be of some medicinal importance, (Raw materials; Wealth of India 1952). The plant is used as a hydrogogue cathartic. The root is anthelmintic and the seeds are given with roasted
pepper during cholera. The juice obtained from the plant is used in the form of liniment in neuralgia and rheumatism and is applied for warts. The latex however, is highly irritating to the mucous membrane and is toxic to the mammary glands and the fish.

The fresh herb contains a non haemolytic saponin, phasin, a neutral saponin and an acidic saponin with haemolytic properties in dry plants (Wechimer 1956).

The total solids of the latex are made up of the rubber hydrocarbons 13 %, resins 62 % and water solubles 25 % (Kirtikar and Basu 1947). The seeds yield 30-33 % of a drying oil with the following characteristics; sp. gr. 1.15; 0.9346, XD 1.4847, sap val. 191.1. Total vol 274.4, acat. val 5.5, unsapon matter 0.78, and insoluble bromoglycerides 53.4 %. The oil has purgative properties (Mitchel and Jennison 1956).