



## CANOLA CULTIVATION IN PAKISTAN

MUSTARD – RAPESEED: *BRASSICA JUNCEA*

CANOLA: *BRASSICA NAPUS L.*



Family: Brassicaceae (Cruciferae)

### 1. INTRODUCTION

Canola, Rapeseed and Mustard are the important crop of Brassica group grown as oilseed crops in Pakistan. These have remained one of the major sources of oil in the sub-continent for centuries. Rapeseed and mustards are rich source of oil and contains 44 – 46% good quality oil. In addition, its meal has 38 – 40% protein that has a complete profile of amino acids including lysine, methionine and cystine.

After many years of breeding and selection in Canada, canola (derived from Canadian oil, low acid) was developed with lower erucic acid in the oil and low glucosinolate content in the meal to be more valuable as cooking oil and an excellent feed for animals and birds especially for poultry. The oil extracted from indigenous varieties of rapeseed-mustard is not being used in the manufacture of vegetable ghee or as vegetable oil because of high erucic acid (40 – 70% in oil) which is harmful to human health. Canola oil is one of the healthiest and most affordable oils available for cooking and the canola meal remaining after oil extraction is an important source of high-protein meal for livestock feed. The improvement in processing and refining techniques have enabled to extend the use of rapeseed and mustard oil as cooking medium, salad ingredient, shortening and in margarine. Recent development of canola quality mustard further enhanced the use of mustard oil for edible purpose.



## 2. USES AND NUTRITIOUS VALUE

- Canola oil is rich in energy; 100 g of oil provides 884 calories. However, its high ratio of mono-unsaturated fatty acids to saturated fatty acids makes it one of the healthy oil for consumption.
- It is one of the cooking oils with a high smoke point; 450 °F. This property can be employed in setting oil temperature while deep-frying food items. Canola oil has very good lipid profile. It has saturated, monounsaturated and polyunsaturated (SFA: MUFA: PUFA= 8: 61: 31) fats in healthy proportions. Cold-pressed oil is one of the stable cooking oil that has a very long shelf life.
- Besides being used commercially in cooking oil, canola is one of the preferred oil that is used liberally in salad dressings, margarines, shortening, deep frying, baking, spreads, and creamers.
- Wide research studies have shown that canola oil can be used safely as edible oil. However, look carefully for the label to make sure it is free from erucic acid and glucosinolates. Erucic acid is an omega-9 fatty acid which occurs in other Brassica family of plants such as rapeseed, mustard... etc.
- Green leaves, particularly of seedling stage are used as vegetable.
- Grown up crop makes a palatable green fodder for the animals, especially when it is mixed with other fodder crops to increase palatability.
- Seeds contain about 40% oil which is an important part of human diet as cooking media in vegetables, frying, flavoring, pickle making and many other preservatives.
- Oil is used as medicine for many digestive problem and swelling.
- Oil is used for softening leather in tanning industry.
- Oil is used in lightening lamps and oil-cakes are used as cattle feed.

## 3. GROWTH STAGES

Canola growth is characterized by six main growth stages.

- I. **Pre-emergence stage:** The germinating seedling may take from 4 to 10 days to emerge. During this time it is susceptible to many soil borne pathogens therefore seed treatment is necessary.
- II. **Seedling Stage:** In this stage the seedling very young plant has just emerged from the soil. Cotyledons are pushed through the soil surface by an active hypocotyl. At this stage, the seedling is still vulnerable to many soil pathogens, and to flea beetle infestation.



- III. Rosette stage:** This stage is the rosette stage characterized by an increasing leaf area index. Spring canola will remain in this vegetative stage for several weeks. Winter canola also stays in this stage for several weeks in the spring. Near the end of Stage 3, the crop is nearing its maximum leaf area index and at that point is a much better competitor.
- IV. Budding stage:** Increasing day length and temperatures initiate bolting and the beginning of the bud stage. The plants reach their maximum leaf area index at this time along with 30 to 60% of its total dry matter. A large accumulation of foliage is required to provide adequate sugars during flowering and pod fill.
- V. Flowering stage** begins and continues for 14 to 21 days. Three to five flowers open per day and 40 to 55% of the flowers that open will develop pods.
- VI. Ripening stage** begins when the petals fall from the last formed flower on the main stem. Pod fill is complete 35 to 45 days after flower initiation, and the seeds contain about 40% moisture at this point. The crop is considered ripe and ready for swathing when 30 to 40% of the seed from pods on the main stem have turned color.

#### 4. TYPES OF MUSTARD

There are some types of Mustard family crops are grown in world for oil purpose.

Botanical Name	English Name	Common Name	Chief Characteristics
Brassica Campestris	Rapeseed	Sarson	The seeds are Bold or large size, round in shape and have a smooth surface, color of the seed yellow or brown or dark brown to black.
Brassica Campestris	Rapeseed	Toria	Seeds are spherical or avoid in shape and are reddish or dark brown in color, having slightly wrinkled surface. Seeds are slightly smaller than those of Sarson.
Brassica Juncea	Mustard	Rai	Seeds are small in size spherical or ovoid in shape and have a distinctly wrinkled surface. Color of the seed is dark brown or black.
Brassica napus	Rapeseed	Canola	Canola is different from rapeseed and it is lower in erucic acid and glucosinolates, which are anti-nutritive and health. Canola type varieties are free of these elements.



## **5. CLIMATE**

Rapeseed and mustard crops are grown in tropical and temperate zones. These grow well from an altitude of 650 – 1500 meters. A warm weather (20°C) during seed germination, 15°C – 20°C during plant growth and long sunny bright days (25°C – 27°C) at flowering and pod formation are most suitable for these crops. Rapeseed and Mustard grow best under relatively cool temperatures upto flowering. These crops grow profusely at 30 – 60% relative humidity. Toria is hardy plant, grows in comparatively warmer and dry season. Among rape and mustard crops, sarson is the most susceptible to frost injury whereas; Rai and taramira are more tolerant to extreme weather condition.

## **6. SOIL**

Rapeseed-mustard can be grown on a wide range of soils including both light and heavy soils. Crop can tolerate a variable range of pH from 5.5 to 8.0. However, the most suitable soils are those that are:

- Deep and free from hardpan, allow good taproot development, uniformly textured, allow even establishment.
- Unlikely to crust after rain, so that the seedling can emerge easily.
- Not prompt to water logging, rapeseed will tolerate winter waterlogging. This applies especially to Brassica campestris.
- Not Acidic with high aluminum and manganese levels.

## **7. LAND PREPARATION**

Rapeseed and mustard crops require a field with proper capillary action, that encourages the movement of water from sub-soil to top-soil and mulching that prevents water loss to the atmosphere. Field preparation depends upon the kind of soil, previous crop and more on intensity of weeds. Sandy loam soils are easy to prepare but require much labour in reducing the menace of some perennial grasses. This requires a comprehensive, deep ploughing, harrowing, collection of stubbles of these grasses and finally planking to conserve the soil moisture. The land is repeatedly ploughed with soil turning plough followed by cross harrowings and planking during cool hours, preferably during night or very early hours of the day. A clean and well pulverized seedbed of good tilth is prepared.



## 8. SEED RATE

Yields are not affected significantly due to varied plant densities. Moderate adjustments in seed rate have little effect on yield. Thin crop stand compensate by extra branching. However, recommended seeding rates are 1.5 to 2.0 kg/acre.

- Lower than normal seed rate will help to reduce lodging and harvest.
- Seed rate above 2.5 kg/acre will result in tall spindly plants prone to lodging.
- Increased seed rate suppresses weed infestation. It has been observed that dense crop stand discourages too many branching and crop matures more uniformly which facilitate combining.

## 9. SOWING TIME

Canola, Rapeseed and mustard are highly photo-sensitive crops. Sowing early or late, both have been reported to be harmful. Loss in yield, due to delayed sowing cannot be compensated by higher seed rate or higher doses of fertilizers.

The planting schedule for different areas is as follows:

- **KPK:** Mid-September to mid-October
- **Punjab:** 1<sup>st</sup> October to 1<sup>st</sup> November
- **South Punjab:** Mid-October to mid-November
- **Sindh:** Mid-October to mid-November
- **Baluchistan:** Mid-October to mid-November

## 10. SOWING METHOD AND SPACING

### a. Broadcast method

Since the seeds of rapeseed and mustard are small in size therefore growers find broadcasting method of sowing very convenient. They spread the seed over the field as even as possible and plough or harrow and then plank the field. This method is not generally recommended.

### b. Line sowing method

Seeds are sown in lines with the help of seed drill. The recommended spacing between lines, among plants and seed depth are given below in table.

S. No.	Crop	Space between lines (cm)	Space between plants (cm)	Depth of sowing (cm)
1	Sarson	30 – 35	10 – 12	3 – 4
2	Toria	25 – 30	8 – 10	2 – 3
3	Rai	40 – 45	10 – 15	2 – 3
4	Canola	30 – 40	8 – 12	2 – 3



## 11. VARIETIES

Research and development efforts of Oilseeds Research Program have made tangible achievements in rapeseed/canola and mustard

### Rapeseed /Mustard/ Canola Varieties/Hybrid Developed at NARC Islamabad

Variety	Institute	Year of release	Yield potential (kg/ha)
<b>Canola</b>			
Westar	NARC, Islamabad	1991	2100
Shiralee	NARC, Islamabad	1991	2500
CON-I	NARC, Islamabad	1996	2800
CON-II	NARC, Islamabad	1996	3000
CON-III	NARC, Islamabad	1996	2500
Pakola	NARC, Islamabad	2007	2620
Canola Raya	NARC, Islamabad	2007	2364
<b>Non – Canola</b>			
BARD-1	NARC, Islamabad	1990	2900
<b>Canola Hybrid</b>			
PARC Canola Hybrid	NARC, Islamabad	2011	3200

### Rapeseed-Mustard Varieties recommended under (National Uniform Yield Trial) NUYT System

Variety	Institute	Year of release	Yield potential (kg/ha)
Raya Anmol	ORI, Faisalabad	1988	2223
Khanpur Raya	ORI, Faisalabad	2000	3223
Pak-Cheen	ARI, Tarnab	1989	2400
Sarhein 95	ARI, Tandojam	1995	3000
Chakwal-Raya	BARI, Chakwal	1996	3450
Tandojam Raya	ARI, Tandojam	2000	-
Abasin 95	NIFA, Peshawar	1996	2300

#### Miscellaneous varieties cultivated in Pakistan

**Canola type:** Dunkeld, Rainbow, Oscar, 19-H.

**Non-Canola:** Sultan Raya, KS-75

**Hybrids (imported):** Hyola – 420, Hyola – 308, Hyola – 401, Pioneer – 45J21.

**Local Hybrids:** Tarnab-I, Tarnab-II, Tarnab-III



## 12. WEED MANAGEMENT

Mustard seedlings are very susceptible to weed competition in the first few weeks after emergence. An effective weed control during this period is vital. The crop canopy usually closes 6 to 8 weeks after emergence and then rapeseed becomes an excellent weed competitor due to increased canopy. Glyphosate (Roundup) is pre-emergence herbicide can be used to control weeds or hand hoeing is also an effective method of weed control.

## 13. IRRIGATION

Irrigation schedule varies with environmental conditions, temperature, rainfall, soil type, and variety/hybrid. In flooding generally rapeseed requires 3 – 4 irrigations depending upon rains. Moisture stress during flowering, pod formation and seed development stages affects the yield.

### Typical Irrigation Schedule for Mustard crops in Thal Desert Punjab, Pakistan

	Oct	Nov	Dec	Jan	Feb	Mar
ET <sub>o</sub>	3.35	2.00	1.43	1.53	2.35	3.78
K <sub>c</sub>	0.35	0.70	0.90	1.00	0.35	0.35
ET mm	1.17	1.4	1.28	1.53	0.82	1.32
Days	21	30	31	31	28	20
ET for the period mm	25	42	40	47	23	26
Precipitation for the period	5	2	8	12	18	26
Net CWR in mm	20	40	32	35	5	00

## 14. FERTILIZER

The phosphorus requirements for good yields of rapeseed or canola are equal to or greater than those for wheat or barley. Rapeseed takes phosphorus from the soil rapidly in the early growth stages and continues to remove phosphorus over a period of more than eight weeks. 2.5 bags/ha of DAP are applied at time of sowing.

Crop responses to fertilizer nitrogen are influenced by soil type, moisture conditions and nutrient balance. High rates should only be applied when a soil test indicates they are needed. Nitrogenous fertilizers are used in split doses i.e. Basal dose of 23 Kg nitrogen will come from DAP and from remaining nitrogen as urea 1.5 bags in November, 2 bags in December and 1.5 bags/ha in January with the fertigation system or by broadcasting.



## 15. DISEASES AND INSECT PEST MANAGEMENT

### DISEASES

#### a. *Sclerotinia* Stem and Root Rot (*Sclerotinia sclerotiorum*)

**Symptoms:** All parts of the plants i.e. stem, root, pod and leaves are attacked. Infected areas show cottony mycelium growth associated with large, round to irregular shaped, black sclerotia (2-15 mm in size). Sclerotia also develop within the pith. At maturity, the diseased tissue tends to shred upon handling. Releasing sclerotia into the soil or in the crop as it is harvested. Occasionally sclerotia are found in pods, side branches. Pods may also be infected and killed.

#### **Control Measures**

- Deep ploughing of soil will help to minimize the disease because burial of sclerotia at 8 cm checks the formation of apothecia and ascospores.
- A long rotation with at least four years between susceptible crops to reduce the incidence and severity of disease.
- Susceptible weed and volunteer plants should be destroyed to reduce the disease problem.
- Routine cleaning of seed followed: spiral cleaner removes nearly all sclerotia. This too will reduce the inoculum in the field.
- Seed treatment (for control of seed contamination by sclerotia of the pathogen); apply Thiabendazole at the rate of 400 mg/100 kg seed.

#### b. Stem, Leaf and Pod Spots, (*Alternaria* black spots)

**Symptoms:** The disease first appear on the cotyledons with light brown spots which rapidly turn black due to appearance of spore masses and act as source of infection for other healthy plant. Leaf spots range from gray to black depending upon moisture conditions. Each leaf lesion may be surrounded by chlorotic area. Lesions consisting of well-marked concentric zones are often seen. Defoliation is an important consequence of leaf infection. Stem and pod spots are brown to black and may become large frequently developing grayish center.

#### **Control Measures**

- Early varieties of rape may reduce loss due to *Alternaria* black spot.
- Weed control appears to be more critical for this disease.
- Use quality seed to reduce the inoculum of the pathogen.
- Seed treatment with fungicides is beneficial to control seed borne diseases.
- Resistant varieties provide the most economical way to control the disease.
- Foliar sprays with systemic fungicide control the disease to some extent but are unpractical for large acreage.



### c. Powdery mildew

This disease is caused by fungus; *Erysiphe cruciferarum*. It occurs at the flowering stage. Dirty white circular flowing patches appear on both sides of lower leaves. Cool and dry season helps the disease to develop. To control powdery mildew spray with Topas 100 EC or any other suitable fungicide is can be used.

### d. White Rust Disease of Mustard (*Albugo candida*)

This disease is caused by fungus *Albugo candida* and *Albugo cruciferarum*. White raised blisters on leaves, stem, petiole and floral parts appear. Cool and wet weather favors development of the diseases. To control (1) use healthy seed (2) keep the field free from weeds.

## INSECT PESTS

### a. APHIDS

Adults and nymphs of this pest suck the sap of the tender leaves, twigs, stems, inflorescence and pods. They secrete excessive, amount of honey dew which interferes the photosynthetic process of the plant. Sometimes aphids cause loss about 40 – 60%. To control the aphids, adjust sowing period in such a way that the crop avoids the pest damage. Early sowing and chemical spray of insecticide is recommended i.e. Master 60 SL @ 1000 to 1500 ml/ha, Lorsben 40 EC @ 700 to 1000 ml /ha, Confidor SL200 @ 250 ml per acre, and Advantage 20EC @ 500 ml per acre.

### b. PAINTED BUG

Both adults and nymphs cause serious damage to seedlings, causing wilt and death of the plants. Thousands of these bugs cluster over the leaves, stems and pods and suck the sap. They hide under clods during day and become active during night. To control: (1) Lorsban 40EC (2) Talstar 10EC (3) Karate 2.5EC (4) Adopt clean cultivation.

### c. Red-legged earth mite (*Halotydeus destructor*) Blue oat mite (*Penthaleus major*):

The mites may seriously damage the crop establishment. They feed the foliage of seedlings and young plants, piercing the outer cells and sucking cell sap. Damaged leaves appear mottled and white or silver and heavily infested leaves may wilt or shrivel. Severely damaged plants usually remain stunted. Heavily infested seedlings and young plants may are damaged severely or killed.



- i. Adult red-legged earth mites are somewhat flattened and about 1 mm long with velvety black bodies and bright red legs. They feed gregariously, usually on the upper side of the leaves.
- ii. Adult blue oat mites are about 1 mm long with pear shaped rounded, purple-blue, greenish blue or black bodies and bright pinkish red legs. Blue oat mites feed either singly or in small groups of five to ten mostly on the underside of the leaves.

## **16. HARVESTING**

The crop matures in 110-190 days depends upon the variety and time of sowing. The pods become yellowish brown and seed moisture is less than 15% (when 60 – 70% pods turn yellow). Seed sound is produced from the pods, when shaken. Harvesting is a critical operation, its optimum harvesting time is very important because early harvesting can reduce seed quality and late harvesting can enhance pod shattering. Crop should be harvested early in the morning. When the plants are moist, otherwise yield losses occur due to shattering.

## **17. THRESHING**

When the harvested crop dries completely, it should be threshed in clear weather. Threshing can be done by thresher, bullocks or tractor after which winnowing is needed to clean the seed.

## **18. YIELD**

A good crop can produce about 100 maunds or 4 tons per hectare of seed depending upon the variety, season and agronomic practices applied is expected from rapeseed and mustard crops.

## **19. STORAGE**

Damp or green seed are impurities in the seeds can be a problem especially when weather conditions at harvest are unpredictable. Ventilation of seed in a store is essential in order prevent heating. It is recommended that seed should be dried properly at 9% moisture content, otherwise it will be damaged by fungi and insects and germination ability will be impaired.



## REFERENCES

- ⇒ An N. Hang, Harold P. Collins & Karen E. Sowers. Irrigated spring and Winter Canola Production in Washington. Washington State University and USDA ARS Prosser, Washington. WSU Extension Manual EM006E.
- ⇒ E.S. Oplinger, L.L. Hardman, E.T. Gritton, J.D. Doll, and K.A. Kelling. Alternative field crops manual. Canola (Rapeseed). University of Wisconsin- Extension, Co-operative Extension, University of Minnesota center for plant and animal products, Minnesota Extension service.
- ⇒ Power your diet. Canola oil nutrition facts. [www.nutrition-and-you.com](http://www.nutrition-and-you.com)
- ⇒ All about /Crop/Mustard. Rapeseed mustard production in Pakistan. [www.pakissan.com](http://www.pakissan.com). Connecting Agri-Community for Better Farming.
- ⇒ E.V. Divakara Sastry. Taramira (Eruca sativa) and its improvement - a review. Department of Plant Breeding and Genetics, S K N College of Agriculture, Rajasthan Agricultural University, Jobner - 303 329. India. Agric. Rev., 24 (4): 235 - 249, 2003.
- ⇒ Rapeseed and Mustard - Booklet No. 158 - Oil Seed Production: OSPS - 9. [www.inseda.org/Additional material/CD - Agriculture and Environment Education/65-oil seed Crops \(PCS\)/ Rapeseed and Mustard-158.doc](http://www.inseda.org/Additional%20material/CD%20-%20Agriculture%20and%20Environment%20Education/65-oil%20seed%20Crops%20(PCS)/Rapeseed%20and%20Mustard-158.doc).

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