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Post-Rainy (*Rabi*) Sorghum Production Technologies and Their Impact

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ARTICLE ID: 74

Rabi sorghum is extensively grown in the states of Maharashtra (31.17 lakh ha), and Karnataka (12.90 lakh ha), while to some extant in Telangana state (3.18 lakh ha), Tamil Nadu (3.18 lakh ha) and Gujarat (0.63 lakh ha). From a stabilized area of about 52 lakh ha in India, about 42 lakh tons of sorghum grain is produced with an average productivity of 817 kg ha-1 during the rabi season. To a greater extant it is grown on stored soil moisture re-filled by the South West monsoon (June-Sept). Productivity of rabi sorghum valued for both food and fodder is mainly driven by the water holding capacity of soil. Soil moisture conservation, use of soil-based high yielding varieties and fertilizer management play major role in improving the productivity of rabi sorghum. In certain areas of Maharashtra, the crop is grown in deep soil with 2-5 irrigations with a stable productivity of 4.0 to 5.5 t ha-1.

Selection of high yielding cultivars and hybrids The rabi sorghum varieties and hybrids recommended for different states are as follows.

State	Area of Adaptation	Hybrids	Varieties
Maharashtra	Rainfed areas (medium to deep soils)	CSH 15 R CSH 19 R	CSV 29R,M35-1,CSV 14 R,CSV 21 R, Parbhani Moti,Maulee CSV 22
	Irrigated areas	CSH 15 R CSH 19 R	Swati , CSV 216 R,CSV 18 R,PKV Kranti, CSV 22, Phule Vasudha
	Shallow soil		CSV 26R,CSV 18 R, Sel.3, Phule Anuradha, Phule Vasudha
Karnataka	Dry Zone (deep soil)	CSH 15 R	CSV 29 R, M 35-1, DSV 4
	Transitional zone (medium soil)	CSH 15 R	CSV 14 R, DSV 5
	Irrigated zone	CSH 15 R	CSV 29 R,DSV 5,CSV 18, CSV

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		CSH 19 R	22R
Telangana	Telangana	CSH 15 R	CSV 29 R,CSV 26 R, CSV 18R,CSV 22R, M35-1
	Normal Rabi crops	CSH 15 R	CSV 29R, M35-1, CSV 26R, CSV18, CSV 22R
Tamil Nadu	Entire rabi area	CSH 15 R	CSV 29R, CSV 26R, CSV 18 R, CSV 22R
	Summer irrigated areas	CSH 15 R	CO 26, CO 24, CoFS 29, CSV 33, CSV 31 (Forage Sorghum)
Gujarat	Entire rabi zone	CSH 15 R	CSV 29R, CSV 26R, CSV 18R, CSV 22R

Preparation of land

One deep ploughing with mould board plough in summer followed by 3 to 4 harrowing is recommended to attain good seed bed and maintain weed free conditions. To improve the water retention compartmental bunds of 10m × 10m in the month of August is recommended.

Method and time of sowing

The crop is sown by bullock drawn seed drills with 2 or 3 coulters at 5-7 cm depth in the soil. The seeds are covered by one harrowing after sowing by seed drill. It is also sown by tractor drawn seed drill with 4 coulters with simultaneous covering of seeds by blade attached to the seed drill.

Time of sowing

The optimum sowing time for rabi sorghum is 2nd fortnight of September to 1st fortnight of October. In double cropping practice sowing is extended up to 2nd fortnight of October.

Seed rate spacing and plant population

Seed rate : 8-10 kg/ha

Spacing : Row to row 45 cm and plant to plant 15 cm

Plant population : In rainfed conditions - 1.35 lakh per ha. In irrigated conditions - 1.50 to 1.80 lakh per ha.

Nutrient management

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Rainfed (shallow to medium soil) : 40:20:00 Kg NPK ha-1 as basal

Rainfed (deep soil) : 60:30:00 Kg NPK ha-1 as basal

Irrigated : 80:40:40 Kg NPK ha (N in two equal splits 50% as basal and 50% at 30-35 days after sowing full P & K at time of sowing)

Inter-cultivation and weed control

Inter-cultivation 2 or 3 time at 3, 5 and 7 weeks after sowing to check the weed growth and also helps conserve soil moisture by providing top soil mulch.

Weed management: Application of Atrazine @ 0.5 kg a.i/ha is recommended for spraying on the soil as pre-emergence application immediately after sowing.

Water management

Under irrigated conditions in medium-deep to deep soils, three irrigations first at germination, next panicle initiation and third at grain filling stage are desirable. Optimum irrigation schedule consists of five irrigations each at 35, 55, 75, 85 and 105 days after sowing which coincides with physiological stages of panicle primordial initiation, boot leaf, flowering, milky and dough stages, respectively. In case of limited availability of irrigation water, it can be restricted to one irrigation and it should be at flower primordial stage or boot leaf stage depending on the soil moisture situation.

Crop-based cropping system

Rabi sorghum is sown after a fallow period (kharif) in medium to deep soil where the rainfall frequency is high. However, double cropping of black gram/ green gram/ cowpea (fodder) and rabi sorghum is recommended wherever found operationally feasible. Soybean + rabi sorghum sequence cropping found feasible and profitable in irrigated conditions. Intercropping of sorghum with safflower in 4:2 or 6:3 ratio is recommended in deep soils

Insect pests and their management

Shoot fly

It is a seedling pest and normally occurs in the 1st- 4th week after germination. Maggot feeds on the growing tip causing wilting of leaf and later drying of central leaf giving a typical appearance of ‘dead heart’ symptoms.

Management

- Planting towards the September end to October first week is ideal to escape shoot fly damage.

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- Increase the seed rate and destroy the 'deadheart' seedlings after removal, to maintain the optimum plant stand
- When planted late, resort to seed treatment with Imidacloprid @14 ml/kg of seed or Thiamethoxam 70 WS @ 3gm/kg of seed.
- Application of Carbofuran 3G at the time of sowing as soil application in the seed furrows @ 20 kg ha-1 can effectively check the pest incidence.

Stem borer

It infests the crop from 2nd week till maturity. Initially, the larvae feed on the upper surface of whorl leaves leaving the lower surface intact as transparent windows. As the severity of the feeding increases, blend of punctures and scratches of epidermal feeding appears prominently. Sometimes 'dead heart' symptoms also develop in younger plants due to early attack. Peduncle tunneling results into either breakage or complete or partial chaffy panicles.

Management

- Uprooting and burning of stubbles and chopping of stems prevent its carryover.
- The borer can be controlled by application of any of the insecticides into the whorl such as Carbofuron 3G, @ 8-12 kg ha-1 at 20 and 35 days after emergence.

c) Shoot bug

- Heavy infestation is seen on the rabi crop, when rain occurs at seedling stage. The nymph and adults suck the plant sap causing reduced plant vigour and yellowing. In severe cases, the younger leaves start drying and gradually extends to older leaves. Sometimes, complete plant death occurs. Management
- Alternate host grasses as related should be removed to buildup of shoot bug. Application of Carbofuran 3G or @ 8 kg ha-1 in the whorls can effectively check the incidence of the pest.

d) Aphids and nymphs prefer to feed leaves. Attack during the boot stage may result in poor panicle exertion. Both the nymphs and adults suck the sap and heavily infested leaves show yellowish blotches and necrosis may occur on leaf edges. They produce abundant honeydew which predisposes the plant to sooty and other sporadic fungal pathogens. Severe damage under moisture stress conditions resulting in drying of leaves as well as plant death.

Management

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Spraying of Metasystox 35 EC (@ 2 ml/ lt of water effectively controls aphids

Diseases and their management

a) Charcoal rot

- Softening of the stalk at the base and premature lodging of the crop.
- Losses in seed size, grain yield and quantity or quality of fodder.

Management

- Minimal doses of nitrogen fertilizer and low plant densities reduce charcoal rot
- Moisture conservation practices like, wheat, paddy straw mulch will provide marginal advantage in checking the disease symptoms
- Seed treatment with talc based farmolation of *Pseudomonas Chlororaphis* @10g/ kg seed reduces the charcoal rot incidence.

b) Stripe virus

- Appearance of continuous chlorotic stripes/ bands between the veins of the infected leaf.
- Affected plants appear stunted in growth. Early infected plant dies sooner or later without emergence of earhead.
- Plants infected at later stages appear dwarf with short internodes, show partial exertion of earhead having few or no seed formations

Management

- Avoid sowing in early September and October-sowing is recommended to reduce stripe virus disease incidence
- Spraying metasystox 35EC or methylS-demeton 35EC @ 5 ml/ 10L water at 15 days interval starting from 20 DAE controls vector and spread of the disease.

Pest management

1. Deep ploughing to expose the larval and pupal stages of shoot fly;
2. Early sowing between last week of September to first week of October for escaping shoot fly incidence;
3. High seed rate @ 10 to 12 kg ha-1 is recommended in case delay in sowing;
4. Inter cropping of sorghum + safflower (2:1 ratio) in rabi season is recommended;
5. Seed treatment with Imidacloprid @14 ml/kg of seed or alternatively Furadon / Carbofuran 50SP@100 g/kg of seed is recommended;

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6. Soil application of Carbofuran 3G granules @ 20 kg ha-1 in furrows at the time of sowing as prophylactia measure to control shoot pest is recommended;
7. Releasing egg parasite, Trichogramma chilonis Ishii @ 12.5 lakh ha-1 is recommended to reduce shootfly incidence in rabi sorghum.

Harvesting and threshing

Crop should be harvested at physiology maturity (110-120 days after sowing) depending upon the genotypes duration. The harvested panicles are left in the field for about a week for drying and thereafter, the grains are separated from panicles by threshing or manually. The panicles are harvested first and remaining plants latter

Drying / Bagging

After threshing, the grains are sundried for 1-2 days to reduce the moisture content up to 10-12%. Bagging of the grains is done in plastic or gunny bags for immediate marketing.

Impact of the technologies

- Although, the area under rabi sorghum reduced with little external recently. However, due to concerted efforts made by the scientists, extension workers, developmental; agencies and farmers, average productivity has now increased.
- More than 1000 FLDs were organized between 2012-13 and 2016-17 with Improved rabi sorghum cultivars namely, CSV 26R, CSV 29R, CSV 18R, CSV 22R, PKV Kranti, Phule Vasuda, Phule Yashodha, Phule Revati, Phule Chitra, Parbhani Moti and Parbhani Jyoti (CSV 18R) in major sorghum growing states Maharashtra, Karnataka and Andhra Pradesh. They gave additional 55% grain and 49% stover yields than the local checks (FP) and obtained 75% more net returns than the local cultivars as shown tin the following figure