

Contingent Crop Planning for Dryland Agriculture in Vidarbha Region of Maharashtra State of India

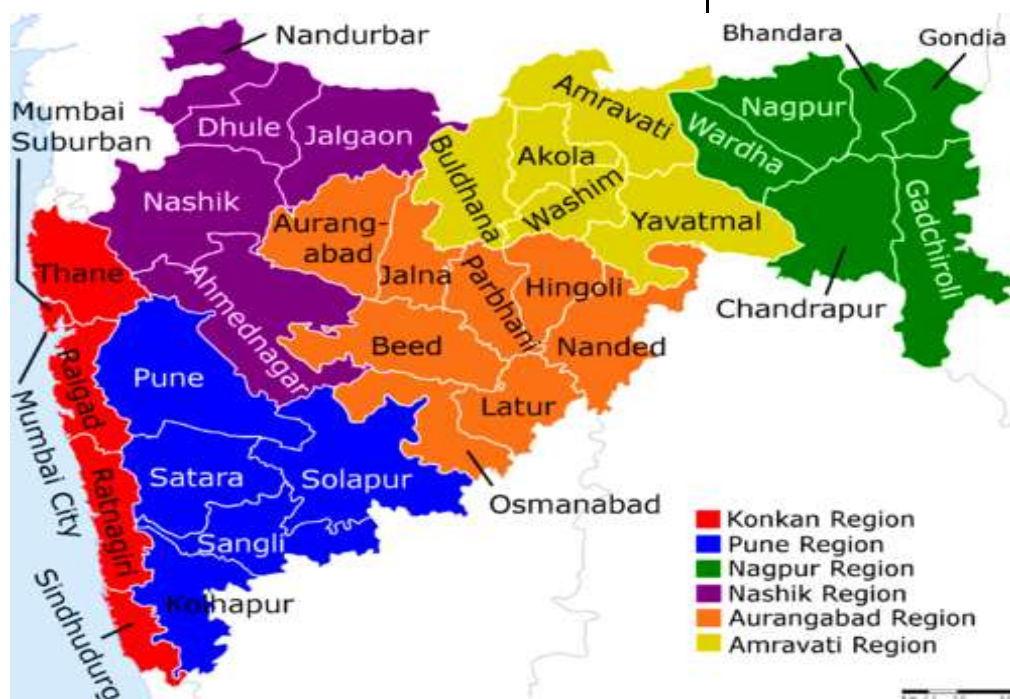
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The Vidarbha region comes under the Deccan Plateau, hot moist semi-arid ESR with medium land deep clayey Black soils (shallow loamy to clayey Black soils as inclusion), medium to high AWC and LGP 120-150 days. (K5Dm4). Vidarbha region has been divided into three agro-climatic zones based on rainfall, soil types and vegetation viz., Western

The mean annual rainfall ranges from 700 mm at the West to 1700 mm at the East. The day length and temperature varies giving a rise from North to South and rainfall from West to East. Thus, it gives rise to various agro climatic situations. Monsoon sets in from 8th June regularly and rains commence in between 18th to 25th June with highest



Vidarbha Zone (Rainfall 700 to 950mm), Central Vidarbha Zone (Rainfall 950 to 1250mm) and Eastern Vidarbha Zone (Rainfall <1250mm). It lies in between 17° 57' - 21° 46' N Latitude and 75° 57' - 80° 59' E Longitude and covers an area of 97762.9 km², which is 31.92 per cent area of Maharashtra. The region comprises of eleven districts viz. Buldhana, Akola, Washim, Amravati, Yavatmal, Wardha, Nagpur, Bhandara, Gondia, Chandrapur and Gadchiroli.

rainfall during July and August and withdraw on 8th October. However, rains are meager after first fortnight of September, Total rainy days ranges in between 47 to 65. The coefficient of variation of monthly rainfall is 40 to 50 per cent even for the wet month i.e. July indicating the uncertainty of rains during the season. The dry spells had been experienced during July, August and

September coinciding with the vegetative or reproductive stages of the major rainfed crops. Cold wave with moderate intensity at least once or twice is the characteristics of winter. The mean minimum temperature ranges from 12.3 to 27.2° C and the mean maximum temperature ranges from 26.2 to 40.8° C. The normal mean monthly maximum temperature is 42.5° C during the hottest month (May), while the normal mean monthly minimum temperature is 10.6° C in the coldest month (December).

Problems / constraints identified in dryland agriculture in the Western and Central Vidarbha region:

- Prolonged dry spells occurring during flowering and pod formation/seed development phases.
- Continuous mono cropping and weather shift causing outbreak of insect pest and disease.
- Lack of irrigation resources and inappropriate rain water management.
- Limited input use and adoption of technology by farmers; mainly inadequate and imbalanced crop nutrition.
- Premature or delayed harvest.
- Lack of mechanization and harvester for small farm conditions.
- Inappropriate post harvest management.
- Price security and market accessibility.
- Lack of awareness and education level of farmers.
- Small land holdings.
- Financial constraints due to poor economic conditions of farmers.

Cropping Pattern

The major rainfed crops cultivated in the Vidarbha region in the semi arid zone during kharif are cotton, soybean, pigeonpea, greengram, blackgram, sorghum and during rabi are chickpea, safflower, wheat and rabi sorghum whereas in summer greengram, maize and groundnut are the major crops of concern for the farmers in the region. Soybean -Chickpea (Sequence cropping) as prominent and major cropping system in Vidarbha region. Soybean + Pigeonpea in row proportion of (4:2)/(5:1)/(6:1) is soybean based major inter-

cropping system followed by the farmers in the region. In cotton based intercropping systems Cotton + Pigeonpea in row proportion of (7:1)/(9:1) is evolving as a prominent intercropping system. Paddy is the major crop grown in eastern Vidarbha region which includes districts viz: Gondia, Gadchiroli, Chandrapur, Bhandara and some parts of Nagpur region.

Contingency crop planning for the major crops cultivated in Western and Central Vidarbha:

In rainfed areas, as a general rule, early sowing of crops with the onset of monsoon is the best practice that gives higher realizable yield. In Western and Central Vidarbha, rainfall is concentrated in just a few months of the year (about 84% of annual rainfall during June-September) and is highly variable in frequency, intensity and geographic coverage. Mainly the swings in the onset, continuity and withdrawal pattern of monsoon make crop production in rainfed areas a risky proposition and hence selection of crops needs to be precisely done in critical situations of dryland agriculture especially during the emergency situations such as late onset of monsoon and delayed sowing. Effective crop selection in these situations can avoid re-sowing and crop failure in the contingency situations. Selection of crops as per the prevailing weather situations in critical rainfall situations of the Western and Central Vidarbha region is given in the table 7.

Crop/cropping system for normal onset of monsoon (second week of June)

- Cotton (AKH-09-5, AKH-9916), Soybean (AMS-1001, AMS-MB-5-18, JS-335 & JS-93-05), Pigeonpea (AKT-8811, Vipula, PKV- Tara & BSMR-736), Sorghum (CSH-9, PDKV Kalyani) Greengram (PDKV Greengold, PKV AKM-4), Blackgram (PDKV Black gold, PKV Udid-15)

- Intercropping systems: Cotton+pigeonpea (8:1/9:1), Cotton+greengram/blackgram (1:1), Soybean+pigeonpea (4:2/6:1), Cotton+cowpea (1:1), Cotton+clusterbean (1:1), Cotton+soybean (4:10)> Safflower, Cotton+soybean (6:6)> mustard.

Suggested contingency crops/ cropping systems and cultivars under delayed onset of monsoon

Delay by 2 weeks (4th week of June)

- Cotton (AKH-081 (Bt), AKH-09-5, AKH-9916), soybean (JS-9560 & JS-93-05), Pigeonpea (PKV-Tara & BSMR-736), Sorghum (CSH-14, CSH-17, CSH-30), Greengram (Pusa vaishakhi, Kopergaon) and Blackgram (TAU-2).
- Intercropping systems: Cotton+pigeonpea (8:1/9:1), Cotton+greengram/blackgram (1:1), Soybean+pigeonpea (4:2/6:1), Cotton+cowpea (1:1), Cotton+clusterbean (1:1), Cotton+soybean (4:10)> safflower, Cotton+soybean (6:6)> mustard.
- Area under cotton be reduced and replaced by sorghum and area under groundnut be reduced and replaced by sunflower.
- Prefer Greengram, Blackgram, Soybean, Pigeonpea as intercrops.
- Delay by 4 weeks (2nd week of July)
- Cotton (AKH-081, AKH-09-5, AKH-9916), Soybean (JS-9560 & JS-93-05), Pigeonpea (PKV-Tara & BSMR-736), Sorghum (CSH-14, CSH-17, CSH-30), Greengram (Pusa vaishakhi, Kopergaon) and Blackgram (TAU-2)
- Intercropping systems: Cotton+pigeonpea (8:1/9:1), Cotton+greengram/blackgram (1:1), and Soybean+pigeonpea (4:2/6:1).
- Prefer early varieties of American/ *Arboreum* cotton
- Replace Sorghum, Greengram and Blackgram

by Soybean (JS-9560 & JS-93 -05) or Pigeonpea (AKT8811, Vipula, PKV-Tara & BSMR-736)

- Adopt 20-25% more seed rate than recommended seed rate and reduce fertilizer dose by 25% for cotton
- Prefer three tier intercropping of Cotton:soybean:pigeonpea:soybean (3:2:2:2) or Cotton:sorghum:pigeonpea:sorghum (3:1:1:1).
- Replace the hybrids with improved varieties in cotton (American cotton: AKH-8828, PKV Rajat (Bt) & AKH-081(Bt); *Desi* cotton: AKA-5, AKA-7 & AKA-8).
- Delay by 6 weeks (4th week of July)
- Sole pigeonpea (AKT-8811, Vipula, PKV Tara, BSMR-736); Sunflower (hybrids) or Sesame (AKT64) or Castor (AKC-1, GCH-4,5,6 & DCH-117, 32) or Pearl millet (PKV Raj, Shraddha, Saburi)
- Intercropping systems: Pearlmillet + pigeonpea (2:1, 4:2).
- Avoid sowing of cotton otherwise use only short duration deshi varieties with 25 to
- 30% more seed rate and reduced intra-row spacing; replace the hybrids with improved varieties in cotton (American cotton: AKH-8828, PKV Rajat (Bt), AKH-081(Bt); *Desi*: AKA-5, AKA-7, AKA-8).
- Avoid sowing of Sorghum, Greengram and Blackgram.
- Alternative crops include Sunflower, Pearlmillet, Sesame, Castor and Pearlmillet + Pigeonpea

Delay by 8 weeks (2nd week of August)

- Pigeonpea (AKT-8811, Vipula); Sunflower(hybrids)/Sesame (AKT64)/Castor (AKC-1, GCH-4,5,6 & DCH-117,32/Pearlmillet (PKV Raj, Shradha, Saburi); Pigeonpea (PKV Tara, BSMR-736); Pigeonpea (AKT-8811,

Vipula); sunflower (hybrids)/sesame AKT64/ Castor (AKC-1, GCH-4,5,6 & DCH-117, 32)/Pearlmillet (PKV Raj, Shradha, Saburi); Greengram, Blackgram.

3. Crop, soil, water and nutrient management strategies during seasonal drought

Early season drought:

- Adoption of risk resilient cotton and soybean based intercropping systems such as Cotton+greengram (1:1), Cotton+cowpea (1:1), Cotton+clusterbean (1:1), Soybean+pigeonpea (4:2), Soybean+pigeonpea (6:1) as preparedness to cope up with drought situations instead of sole cropping of cotton and soybean for assured and sustainable crop production.
- Sowing of cotton and soybean on broad bed furrow through BBF planter for in-situ moisture conservation and to cope up with moisture stress during early season drought.
- Raising of cotton seedlings in polythene bags for transplanting when sufficient moisture is available after receipt of rains can be practiced to compensate loss in plant stand with seedlings of similar age.
- If moisture stress occurs at very early stage i.e. within a week to 10 days after sowing, it is recommended to resow with subsequent rains for better plant stand.
- In case of failure of kharif crops, prefer sowing of photo insensitive crops such as Pearl millet, Sunflower, Sesame and Pigeonpea once adequate rains are received.
- Gap filling to be done by pot watering 7 to 10 days after sowing when crop stand is less than 75%.
- Interculture for removal of weeds and creating soil mulch.
- Open conservation furrows in each row in cotton and soybean by tying a rope to hoe and furrow across the slope for in-situ moisture conservation.
- In Pigeonpea, gap filling either with sesame or maize.
- In Sorghum, adopt thinning to maintain optimum plant population.
- Avoid applying fertilizer till sufficient moisture is available in soil.

Mid-season drought

- Take up repeated interculture to remove weeds and create soil mulch to conserve soil moisture.
- If severe moisture stress, ratooning or thinning may be done in kharif sorghum and pearl millet.
- Open conservation furrows in each row in soybean and cotton for in-situ moisture conservation by tying a rope to hoe during hoeing.
- Open alternate furrows in row crops such as soybean or furrows for every 6-8 rows of Pigeonpea with Balaram plough in medium to deep soils.
- Foliar spray of 2% urea solution at flowering stage in cotton to supplement nutrition during mid-season drought.
- Foliar spray of 19:19:19 mix water soluble fertilizer at pod initiation stage in soybean to supplement nutrition during mid-season drought.
- Avoid top dressing of fertilizers until receipt of rains.
- Adopt surface mulching with crop residue or tree loppings of Glyricidia wherever possible.

c. Terminal drought

- Provide lifesaving or supplemental irrigation, if available preferably through sprinkler or drip irrigation at pod development stage in soybean and at boll development stage of cotton during prolonged dry spells of terminal drought.
- Harvest at physiological maturity with some reliable yield or harvest for fodder and prepare for rabi sowing in double cropped areas.
- Foliar spray of 1% KCl at boll development stage in cotton to supplement nutrition during prolonged dry spell.
- Advantage of this situation is exploited for double cropping with safflower and chickpea.
- Safflower may be sown after sorghum till 15th October. Beyond 15th October, chickpea may be sown.

Area, production and productivity of major crops cultivated in Western and Central Vidarbha region

Table No. 01. District wise Area (A), Production (P) and Productivity (Py) of major Kharif Crops cultivated in Western and Central Vidarbha

Particulars		Soybean			Cotton lint			Pigeonpea			Greengram		
Sr.	District	A ("00ha)	P ("00 ton)	Py (Kg/ha)	A ("00ha)	P ("00 ton)	Py (Kg/ha)	A ("00ha)	P ("00 ton)	Py (Kg/ha)	A ("00ha)	P ("00 ton)	Py (Kg/ha)
1	Akola	2166	2656	1226	1591	3355	359	541.16	504	931	202.98	12	61
2	Amravati	2387	2203	923	2761	7404	456	1000.12	1011	919	126.78	7	56
3	Buldana	4157	6951	1672	2035	4751	397	949.54	1426	1502	180.73	89	494
4	Washim	3000	5253	1751	218	818	639	626.56	535	854	75.3	56	750
5	Yavatmal	2851	2851	1000	4734	7620	274	1375.62	799	581	56.10	19	331
6	Wardha	1257	680	541	2435	5949	415	716.33	1328	1855	0.16	0.1	340
State Total		16150	20990	1186.4	19180	43919	425.8	5420.18	5774	1064.8	897.92	249.1	327.14

(Source: Maha-agri, Department of Agriculture, Govt. of Maharashtra, 2020-21)

Table No. 02. District wise Area (A), Production (P) and Productivity (Py) of major Rabi and Summer Crops cultivated in Western and Central Vidarbha:

Particulars		Rabi Crops						Summer Crops					
		Wheat			Chickpea			Maize			Groundnut		
Sr.	District	A ("00ha)	P ("00 ton)	Py (Kg/ha)	A ("00ha)	P ("00 ton)	Py (Kg/ha)	A ("00ha)	P ("00 ton)	Py (Kg/ha)	A ("00ha)	P ("00 ton)	Py (Kg/ha)
1	Akola	278.83	399.40	1433	842.71	970.08	1151	0	0	0	35.05	43.07	1228.96
2	Amravati	430.46	721.73	1677	947.83	1178.26	1243	11.31	20.31	1795.50	12.91	11.85	917.98
3	Buldana	555.60	1120.18	2016	1916.64	2391.04	1248	64.75	117.38	1812.80	53.35	104.05	1950.60
4	Washim	359.72	570.05	2419	662.84	1045.19	1577	0	0	0	79.94	254.45	3182.89
5	Yavatmal	488.90	698.42	1429	1238.19	1425.17	1151	0	0	0	105.70	114.21	1080.56
6	Wardha	158.88	342.46	2155	477.37	806.64	1690	0.33	0.43	1302.46	12.85	20.69	1610.59
State Total		19091.9	16328.8	855.2	23217	25973.5	1118.7	141.09	271.4	995.8	312.89	571.82	1680.99

(Source: Maha-agri, Department of Agriculture, Govt. of Maharashtra, 2020-21)

Table No. 03. Normal sowing window of rainfed crops cultivated in Western and Central Vidarbha

Sowing Window					
Kharif Crops				Rabi Crops	Summer Crops
Cotton	Soybean, pigeonpea	Greengram	Sorghum	Chickpea, Sorghum, Maize	Greengram, Groundnut and Maize
Entire June	Third week of June to second week of July	Third to fourth week of June	Third week of June to first week of July.	Third week to fourth week of October	2 nd week of January to 1 st week of February

Table No. 04. Crops and varieties/hybrids suggested for cultivation in Western and Central Vidarbha

Crop	Varieties/	Yield Potential (kg/ha)	Duration	Tolerance to abiotic and biotic stresses
Cotton	AKH-09-5	1200-1500	170-80	Tolerant to drought, resistant to arm, tolerant to grey mildew and Jassids and resistant to wilt
	AKH-9916	1200-1500	170-180	-do-
	PKY HY-2 (BG-II)	1200-1500	170-180	-do-
	PDKV JKAL (BG-II)	1500-1800	180-200	-do-
	AKA-5	700-800	170-180	-do-
	AKA-7	1000-1200	140-150	-do-
	AKA-8	1000-1200	170-180	-do-
Soybean	JS-335	2200-2400	98-105	-
	AMS-1001 (PDKV Yellow Gold)	2200-2600	95-100	-
	AMS-MB-5-18 (Suwarn Soya)	2400-2800	98-102	-
	JS-9560	1800-2000	82-88	-
	JS-9305	2000-2400	90-95	-
Pigeonpea	TAT-10	800-900	110-115	-
	ICPL-87	900-1000	125-135	Tolerant to drought, resistant to wilt and sterility mosaic
	AKT-8811	1000-1100	130-140	Tolerant to drought
	BDN-2	900-1000	170-175	Resistant to wilt
	PKV Tara	1900-2000	178-180	Tolerant to drought, resistant to wilt and sterility mosaic
	BSMR-853	1300-1400	178-180	- do-
	BSMR-736	1300-1400	180-200	- do-
	Asha (ICPL-87119)	1200-1400	180-210	- do-

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Greengram	PDKV Greengold	1000-1200	65-70	Medium Tolerant to powdery mildew
	PKV AKM -4	800-100	65-70	Kharif and summer cultivation and multi disease tolerant
Sorghum	CSH -14	4200-4500	100-105	-
	CSH -17	4200-4500	100-105	-
	CSH -30	4000-4500	100-105	-
	CSH -9	4500-4800	100-105	-
	CSH -16	4500-5000	110-115	-
	CSH -25	4500-5000	110-115	-
	SPH-1635	4800-5000	110-115	-
	CSH -35	4800-5000	110-115	-
	SPV-669	3800-4000	115-120	-
	SPV-15	3600-3700	115-120	-
	PVK-400	3500-3600	115-120	-
	SPV-1616	3600-3800	115-120	-
	CSV-23	2500-3000	110-115	-
	CSV-27	2500-3000	110-115	-
	CSV-28	2500-2800	115-120	-
	PDKV Kalyani	3500-4000	115-120	-
	CSV-34	3800-4000	110-112	-

Table No. 05. Crops and varieties suggested for Rabi season in Western and Central Vidarbha

Crop	Varieties/ hybrids	Yield Potential (kg/ha)	Duration	Tolerance to abiotic and biotic stresses
Chickpea	JAKI-9218	1800-2000	105-110	Tolerant to wilt
	PDKV Kanchan	2100-2300	105-110	-do-
	PKV Kabuli-4	1600-1800	100-125	-do-
Sorghum	CSH-15 R	2800-3000	120-125	-
	CSH-19 R	3800-4000	115-120	-
	PKV Kranti	2500-3000	120-125	-
	SPV-504	2200-2400	120-125	-
	CSV 14 R	2500-2600	120-125	-
	Phule Yashoda	2500-2600	120-125	-
	CSV 18 R	3300-3400	120-125	-
	AKS-207	1400-2000	125-130	-
Safflower	Bhima	1200-2000	130-135	-
	Nari-6 (thornless)	1000-1500	135-137	-
	PKV Pink	1500-1800	135-140	-

Table No. 06. Crops and varieties suggested for Summer season in Western and Central Vidarbha

Crop	Varieties/ hybrids	Yield Potential (kg/ha)	Duration	Tolerance to abiotic and biotic stresses
Groundnut	TAG-24	2400-2600	110-115	-
	TAG-76	2500-2800	110-115	-
Greengram	PDKV Greengold	1000-1200	65-70	Medium Tolerant to powdery mildew
	PKV AKM -4	800-100	65-70	Kharif and summer cultivation and multi disease tolerant
Maize	PKVM Shatak	5500-6000	90-100	-
	African Tall	4000-5000	100-110	-
	Pusa Hy-1	4000-5000	80-90	-
	Vivek Hy-21	4500-5000	80-90	-

Table No. 07. Cultivation of crops in real time as per prevailing contingent situation

SN	Time of arrival of sufficient rains for sowing	What crops should be grown?	What crops should not be grown?
1	15-30 June	All kharif crops	-
2	1-7 July	All Kharif crops	-
3	8-15 July	Cotton, Hybrid Sorghum, Hybrid Millet, Soybean, Tur, Sesame and Sunflower	Groundnut, Greengram and Blackgram.
4	16-31 July	Hybrid Millet, Sunflower, Tur, Soybean, Millet castor and Coriander	Cotton, Hybrid Sorghum and Groundnut
5	1-15 August	Castor, Sesame, Millet, Ragi, Sunflower, Tur, and Coriander.	Cotton, Hybrid Sorghum and Groundnut
6	16-31 August	Millet, Sunflower, Tur, Castor and Coriander	Cotton, Sorghum, Groundnut, Ragi and Sesame
7	20-30 September	Rabi Sorghum, Safflower and Sunflower	Gram, Linseed and Wheat
8	1-15 October	Rabi Sorghum, Safflower and Linseed	Sunflower and Wheat
9	16 th October to 1 st November	Gram, Safflower, Wheat and Linseed	Rabi Sorghum and Sunflower

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