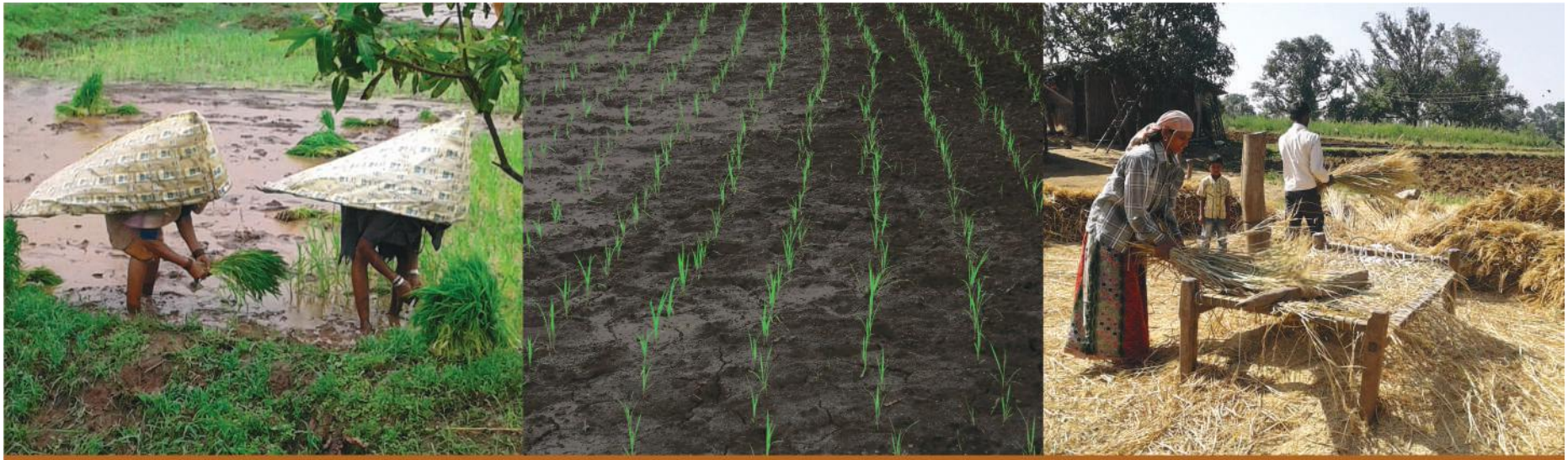
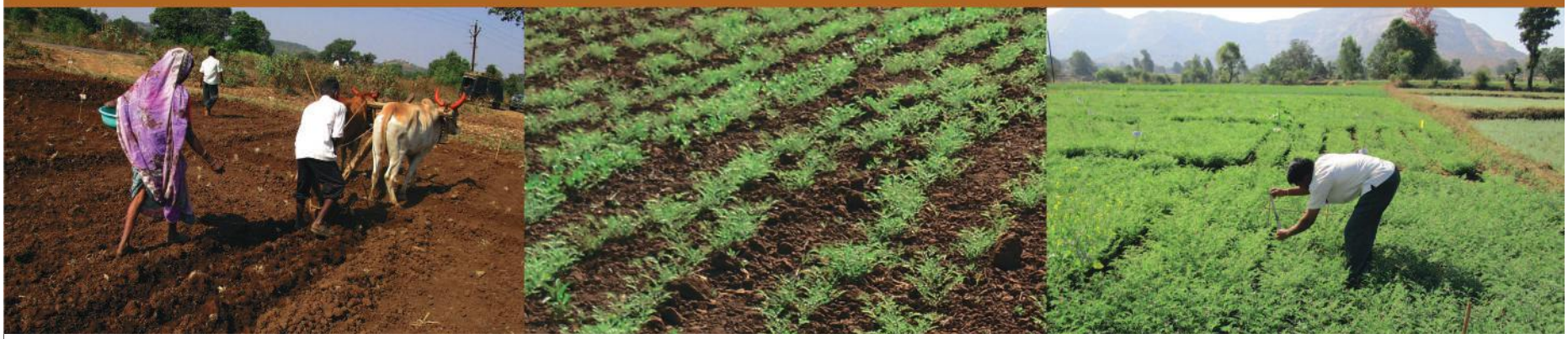


Making Agriculture Climate Smart

A Compendium of Weather-Based Advisories for Management of Paddy-Chickpea Cropping Sequence in Sakri Block of Dhule District, Maharashtra



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Foreword

Agriculture is highly dependent on climate and climate variability is increasingly observed in erratic weather, in occurrences of those that are beyond human control. In such circumstances however, one can to an extent adapt to or mitigate the effects of erratic weather when timely weather forecast is obtained by farmers which will help them, in foresight to take appropriate action to either mitigate, reduce or make suitable coping plans when faced with climate risks. This publication is a step towards providing Agro-met advice to guide farm level decision-making practices, the implementation of which will help to prevent or minimize weather-related crop damage or loss.

There are four important aspects to be given attention, when planning action in climate change scenarios: (a) adaptive crop management practices in varying weather conditions; (b) improving farm productivity; (c) maintaining the health of ecosystems; and (d) improving soil health. These need to be guided by reliable local weather forecasts, to optimize benefits from a good weather, or manage weather-related risks. Sustainability in farming depends on the last two points. This publication attempts to meet these requirements

Although generalized, agriculture is actually local specific. The approach that we advocate and the recommendations given are specific to the Sakri Block of the Dhule District in Maharashtra. The focus is on the two key crops in the region - Paddy in kharif (monsoon) and Chickpea in rabi (winter) seasons. Based on different weather scenarios, recommendations are given across key aspects of crop management - crop varieties, irrigation, nutrient, pest and disease management and cultural practices. Our approach emphasizes the use of locally available material and nature-friendly practices, with an aim to fulfil two important objectives: make farming both viable and sustainable.

I would like to express sincere thanks to the GIZ and the BMZ who have generously funded this project, titled “Soil protection and rehabilitation of degraded soils for food security in India”. A special mention must be made of the Agro-Meteorology Team in WOTR who researched and prepared this publication. This team designed and launched a pioneering service that provides timely integrated weather- based, crop specific advisories to farmers through a multi-media format – SMSs, public address systems, wall papers and on-farm extension support. This experience has given us rich insights, which we have documented and incorporated here.

I am delighted to also mention that the Watershed Organisation Trust has received the United Nations “Land for Life Award 2017”, an award given for our efforts to combat land desertification. Having won this award, we rededicate ourselves to regenerating degraded land and provide better livelihoods and living conditions to rural communities.

This Crop calendar requires continuous feedback to update the information and make it more efficient. We solicit your support and welcome any feedback that will make crop advisories even more useful for our farmers.

Dr. Marcella D’Souza
Executive Director
WOTR

Message

According to recent findings 1/3rd of India's soil is either degraded or wasteland (ICAR 2010) and Dr. Harsh Vardhan, Honorable Minister MoEFCC, during the recent Asia-Pacific meeting of UN Convention to Combat Desertification (UNCCD, April 2018) said "…every minute we are losing 23 ha more". Soil degradation, in combination with high population growth and additional threats caused through climate change raises high level of concern. It is of utmost importance to design a strategy to avoid further degradation, reduce loss of fertile land and reverse the degradation process making land degradation a net plus business. This holds a special importance in view of Govt. of India's targets setting for Sustainable Development Goal (SDG) 15.3 on Land Degradation Neutrality (LDN).

Since 2015 GIZ in collaboration with NABARD has been implementing The Program: Soil Protection and Rehabiliation for Food security in India (ProSoil) as part of the global initiative "One World, No Hunger" (SEWOH) by the Government of Germany. ProSoil is committed to protect and rehabilitate soils in India and thus closely cooperates with WOTR in order to support small holder communities in Maharashtra in selected villages of Sakri block of Dhule District amongst other districts and blocks.

Providing weather based agricultural advice and training on sustainable agricultural practices to farmers shall lead to increase in yield and farm incomes and will make India's farming sector more resilient toward climate change. We are jointly introducing the digital advisory platform Network for Information on Climate (ex)Change, NICE and studying possibilities for soil carbon and nutrient enrichment through the initiative on Urban-Rural Nutrient and Carbon Cycle (URNCC).

Keeping the above approach in mind, this Crop Weather Calendar would be an excellent tool for farmers in Sakri block, Dhule to schedule different farm operations and to adapt protective measures. An initiative that has huge potential for similar agro-ecological contexts in the country.

Our long-lasting legacy in the field of watershed management has been furthered towards sustainable soil management and we are thriving to contribute to the land degradation neutrality agenda of Government of India. The idea is to support policy makers in strengthening policies through evidence-based actions on the ground.

I commend this effort by the WOTR team in bringing out this publication and wish them all the best for their future endeavors to help rural communities to cope with and sustain themselves in erratic weather conditions.

Dirk Walther
Project Director
Soil Protection and Rehabilitation in India (ProSoil)

Message

Since last two and half decades, the climate changes are becoming the most serious threats for sustainable development of the economy. The adverse impact is expected to be on environment, human health, food security, economic activity and finally agriculture. The climate of a region determines the nature of crops to be grown; but prevailing weather conditions during the crop growth period decides the final crop yield. The small and marginal farmers in India are increasingly facing climate related induced disasters and vulnerabilities affecting their lives and livelihoods. It has been proved that when other inputs are supplied at the optimum level, the variation in the productivity of crops are to be attributed to the prevailing weather conditions like rainfall, solar radiation, humidity, temperature, etc.
I am happy to note that, the scientists from the M.P.K.V, Rahuri and the Watershed Organization Trust (WOTR) have made such an attempt in developing weather-based calendars for Paddy and Chickpea crops. The major objective of this publication is to help the farmer as a decision support system to plan out various agricultural practices in an integrated manner in the context of climate variability.

I congratulate to Dr. H. M. Patil, Zonal Agriculture Research Station, Igatpuri and Dr. N. S. Kute, Pulses Improvement Project, MPKV, Rahuri and the Watershed Organization Trust, (WOTR) for bringing out this publication on "Crop Weather Calendars". The schedules given in the calendar will guide and help the farming community by integrating nutrient, weed, water, and integrated pests and disease management of Paddy and Chickpea crops in order to face the challenge of climate change in Sakri block of Dhule district (M.S). Moreover I am sure that, this effort will also be beneficial to resource managers and planners for input management.

I appreciate the efforts of authors for bringing out this bulletin in a simple language, especially by explaining the relationship between weather parameters, agronomic practices, pests and disease incidence in the form of bulletin.

Dr. Sharad Gadakh
Director of Research
Mahatma Phule Krishi Vidyapeeth, Rahuri

Introduction

Agriculture in India is highly vulnerable to climate change especially in rain-dependent regions which constitute over 60% of India's cultivated area.

Maharashtra, India's second largest state on the western seaboard is particularly vulnerable with 83% of its cultivated area directly dependent upon the monsoons for agricultural production. Changing weather patterns - early or late onset and withdrawal dates of monsoons, unseasonal dry and wet spells, erratic rainfall, extreme temperature fluctuations and unexpected events like hailstorms, cloud bursts and storms - increase risks to crops, livestock and livelihoods thus making the farmer vulnerable to losses and damages. Unfamiliar weather patterns and shifts in local weather dynamics are increasingly leaving farmers at a loss as to how to cope. Their traditional knowledge and experience, honed over millennia, needs to be complemented by advance information of likely weather occurrences and science-based advisories as to what measures they need to undertake to protect their crops and livestock while increasing productivity. These advisories, however, must be crop and locale-specific as agriculture is highly dependent on local meteorological, hydrological, soil and landscape conditions. Farmers must be provided crop advisories specific to their farm conditions and the crops that they grow.

This publication is a step forward in this direction. Its target group is the farmers growing paddy in *kharif* season and chickpea in *rabi* season at Pimpalner region of the Dhule District. Its purpose is to provide information and advisories regarding various management practices that the farmer would need to undertake under different weather conditions that may arise locally. Adopting these recommended practices and interventions would help farmers cope with unexpected and different weather events, reduce risks

and losses and build their resilience to nature's vagaries. The expected outcome is that farmers of the Pimpalner region would be better adapted to coping with climate change and better equipped to address emergent situations.

The Watershed Organisation Trust (WOTR) has been working in the Sakri Block since the last 3 years, organizing communities regenerate the watersheds they live in and adopt sustainable agricultural practices. As part of its "Soil protection and rehabilitation of degraded soils for food security in India" in 5 villages of this block, WOTR, in collaboration with the Mahatma Phule Krishi Vidyapeeth (MPKV) has undertaken a study to develop weather-based contingency and adaptive strategies for 2 key food crops i.e. Paddy followed by Chickpea cultivated by the farmers in the Pimpalner region of Dhule District.

Agro-Climatology of Sakri Block

The state of Maharashtra is divided into nine broad Agro-Climatic Zones. Sakri block comes under the Western Maharashtra Plain Zone /Transition-2. This area suffers from the twin problems of low productivity and high instability as a result of inadequate and unpredictable rainfall. The average annual rainfall is about 700 to 1200 mm. Soils of the Sakri block have been classified as Shallow (up to 30 cm), Medium (30-60 cm) and Deep soils (60- 90 cm). The zone is predominantly a kharif tract suitable for rainfed crop. Major crops grown are Paddy, Finger millet, Soybean, Maize, Groundnut and Pigeonpea during *kharif* season whereas in *rabi* season Wheat and Chickpea are major crops.

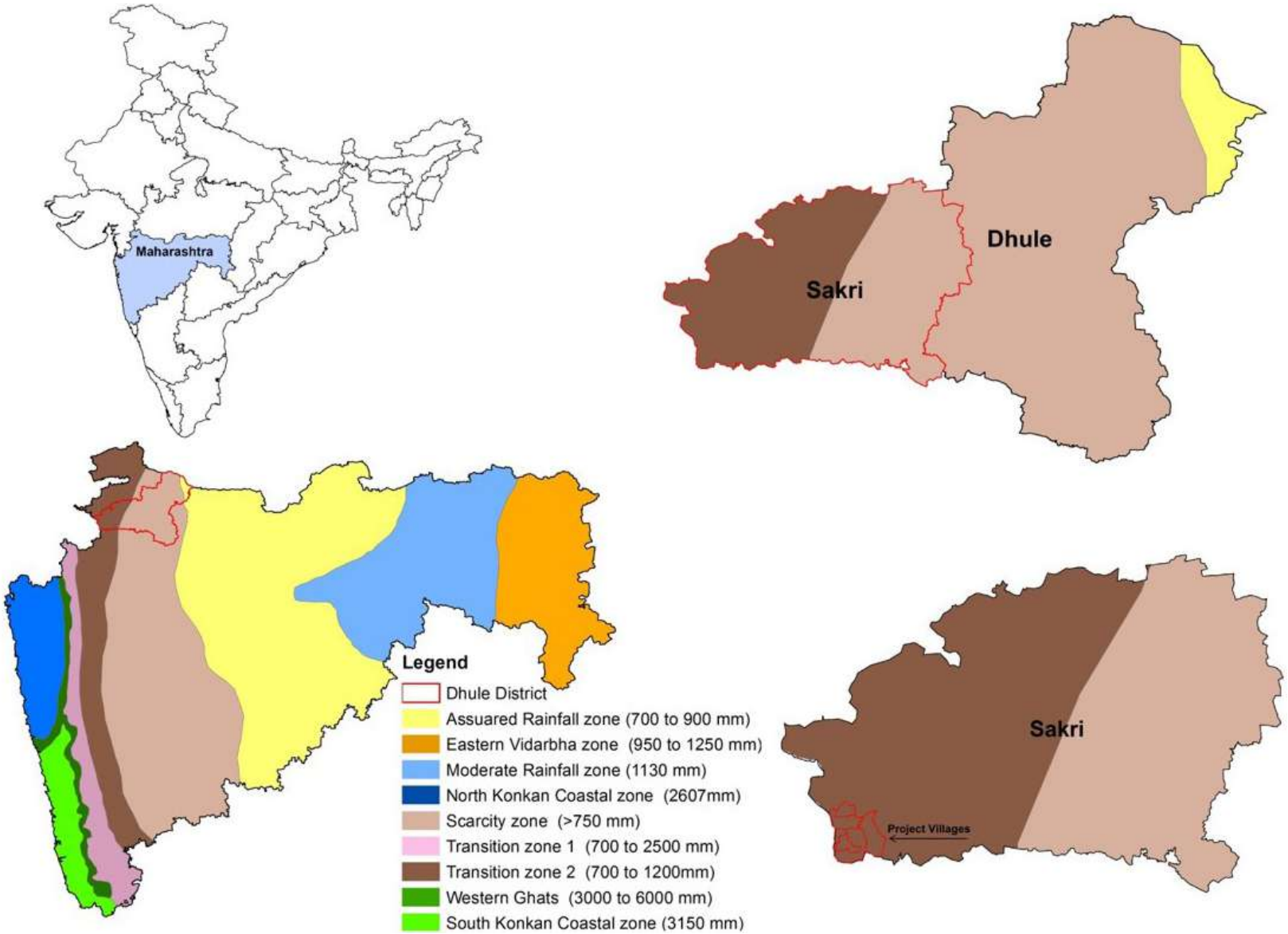


Diagram 1: Agro-Climatic Zones of Maharashtra with specific reference to Sakri Block

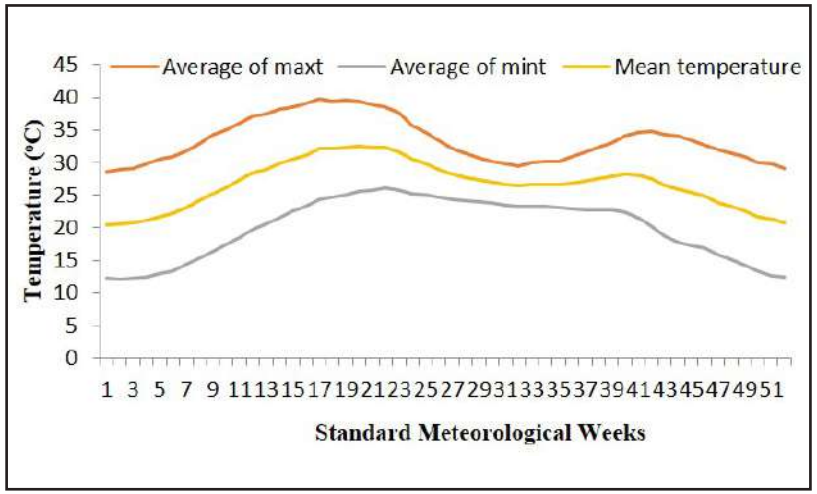


Fig 1a. Maximum, minimum and Mean Temperature (^{0}C)

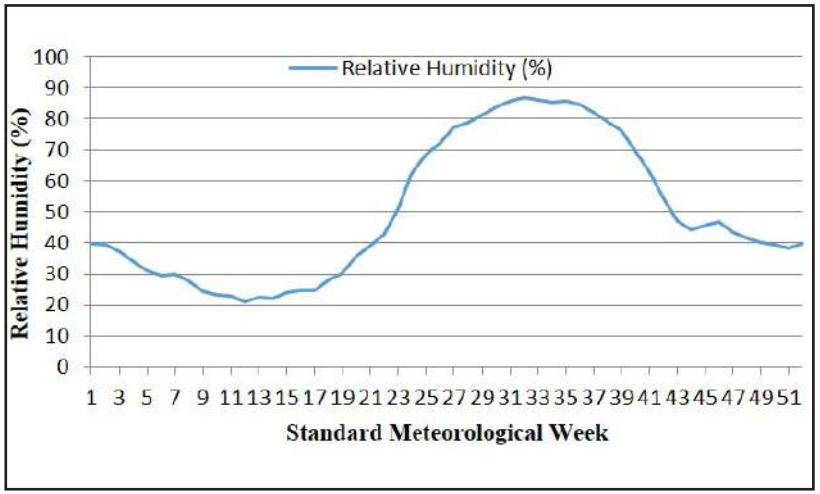


Fig 1b. Relative Humidity (%)

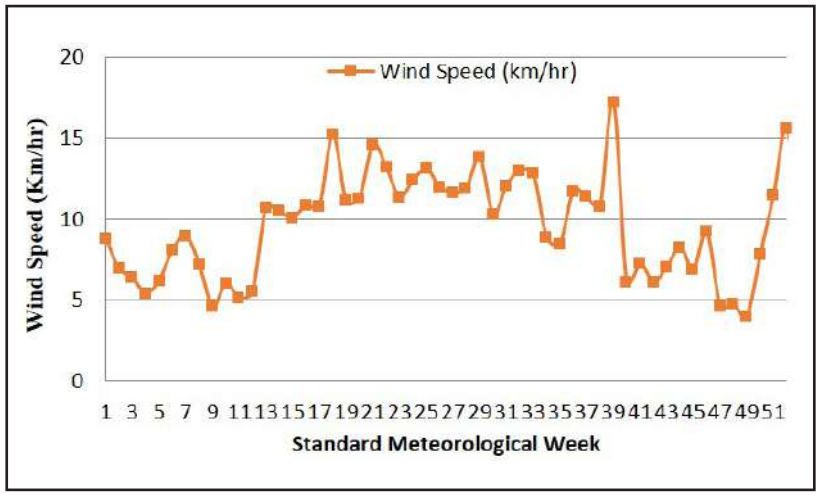


Fig 1c. Wind Speed (Km/hr)

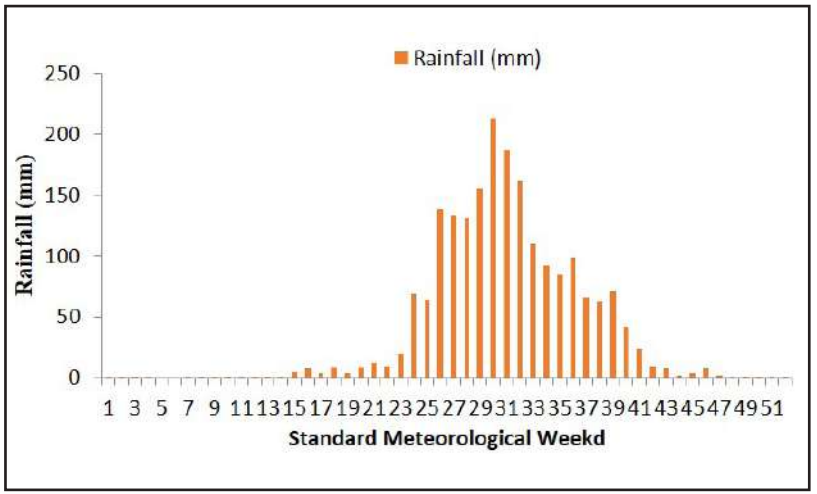


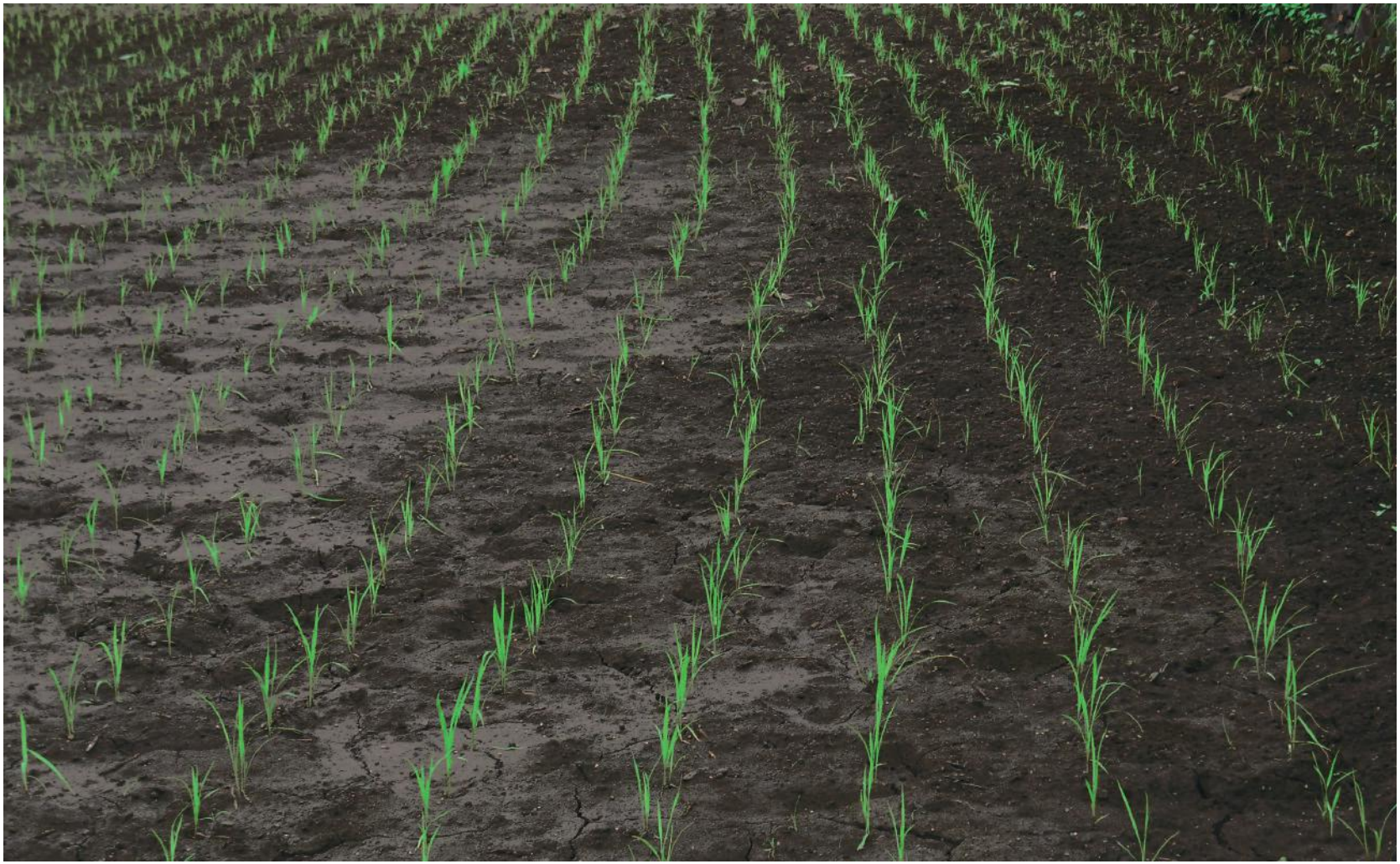
Fig 1d. Rainfall (mm)

Fig 1: Weekly climatic normal (30 years data analysis) of weather parameters i.e. rainfall (mm), maximum and minimum temperatures (°C), relative humidity (%), and wind speed (km/hr) of Sakri, Maharashtra

Source: http://globalweather.tamu.edu

Methodology and Classifications Used

For preparing this weather-based crop management compendium, thirty years weather data of Sakri Block has been studied for all major weather-related aberrations including extreme events viz., droughts, high temperature, low temperatures, high intensity rainfall, frost and hailstorms, together with major cropping systems. However, since Sakri block is largely subjected to periodic dry spells, high intensity rainfall, irregular and deficient rainfall, we have focused our advisories primarily on addressing this risk.



Weather Scenarios:

We have considered the following 8 likely weather scenarios that may occur during the season which would affect the growth and development of crops.

(i) Normal weather condition: This weather is what is generally experienced as a long term trend. We consider here the climatic normals of rainfall, temperature (minimum and maximum), relative humidity, cloud cover and wind speed defined on a Standard Meteorological Week basis.

(ii) Rainfall received >15 mm in one or two consecutive days

(iii) Rainfall received >30 mm in one or two consecutive days

(iv) Sufficient rainfall followed by clear sky and high RH

(v) Light rainfall, intermediate cloudy sky/ moderate humidity

(vi) No rains, cloudy sky, low RH

(vii) No rains, cloudy sky, high RH

(viii) No rainfall, hot and dry winds during day time

Nature of Recommendations

Recommendations made are based on the phenological growth stage of the crop as well as the likely weather patterns (including the "normal" weather) that may be experienced during the course of a Standard Meteorological Week (SMW) covering the entire life-cycle of the crop – from sowing to harvesting. Emphasis is given to integrated practices and interventions that promote soil health, are environmentally friendly, build upon effective traditional knowledge, are low cost and use locally available material and inputs, as far as possible. An integrated System of Crop Intensification (SCI) that includes management practices and the use of biological, organic and inorganic formulations (this latter only when needed) has been developed with a view to increasing productivity sustainably and controlling pests and diseases. Moreover, since the growth and productivity of crops critically depends on moisture availability, appropriate cultivars and plant population, emphasis has been given to in-situ moisture conservation, crop geometry and integrated management practices.

The Appendix at the end of this publication gives instructions on preparation of organic and plant based formulations from locally available material for enhancing plant growth, soil health and controlling pest and diseases – *Amritpani, Jeevamrit, Dashaparni ark* and 5% Neem Seed Kernel Extract (NSKE).
Recommendations are also made based on when the crops are sown ("Period of Sowing"), which is particularly important in the case of Paddy and chickpea

Pest and Disease Management

Details about control measures at various stages of crop growth are furnished in Annexure I (Pests) and Annexure II (Diseases) after each crop discussed.

The purpose of this publication is to address the challenges posed by climate change to farmers in rainfed regions of India. It is our hope that the various weather scenarios described and the related crop management advisories provided will help the dryland farmer anticipate, plan for and undertake the necessary operations that will minimize her/his crop losses, increase productivity and enhance soil health.

Paddy

Weather Based Management of Paddy (*Oriza Sativa* L.) Cultivation

1. Introduction[1]

Paddy is the most important and extensively grown food crop in the World. It is the staple food of more than 60 percent of the world population. Rice is mainly produced and consumed in the Asian region. India has the largest area under paddy in the world and ranks second in the production after China. Country has also emerged as a major rice consumer. Rice is primarily a high energy calorie food. The major part of rice consists of carbohydrate in the form of starch, which is about 72-75 percent of the total grain composition. The protein content of rice is around 7 percent. The protein of rice contains glutelin, which is also known as oryzenin. The nutritive value of rice protein (biological value = 80) is much higher than that of wheat (biological value = 60) and maize (biological value = 50) or other cereals. Rice contains most of the minerals mainly located in the pericarp and germ and about 4 percent phosphorus. Rice also contains some enzymes.

Rice is a crop of tropical climate. However, it is also grown successfully in humid to sub-humid regions under subtropical and temperate climate. Rice is cultivated in almost all types of soils with varying productivity. Under high temperature, high humidity with sufficient rainfall and irrigation facilities, rice can be grown in any type of soil. The major soil groups where rice is grown are riverine alluvium, red-yellow, red loamy, hill and sub-montane, Terai, laterite, costal alluvium, red sandy, mixed red, black, medium and shallow black soils. Rice being a tropical and sub-tropical plant, requires a fairly high temperature, ranging from 20° to 40°C. The optimum temperature of 30°C during day time and 20°C during night time seems to be more favourable for the development and growth of rice crop. Rainfall has direct impact on deciding the ecosystem.

WOTR promoted system of rice intensification (SRI) in sustainable way. SRI technique is based on four major principals i.e. 1. Transplanting of seedling should be done 12 to 15 days after sowing. 2. Incorporation of green leaves of glyricidia @ 3 tons per hectare 3. Square planting of seedling at 25 x 25 cm and use of urea DAP briquettes. 4. Alternate wetting and drying.

[1] This section has been taken and adapted from: http://agmarknet.nic.in/rice-paddy-profile_copy.pdf and Dr. C. Singh, P. Singh and R. Singh (2010), Modern Techniques of Present Field Crops, Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi

2. Phenological Growth Stages of Paddy[2]

Stage 1: **Nursery preparation:** For raising seedlings in the nursery, select a fertile, well-drained, upland field near the source of irrigation. For transplanting 1 ha area, about 500 sq m nursery area is sufficient. In case of late sowing, increase the nursery area to 750–1,000 sq. m. In the case of bold grain varieties like Jaya and IR-8, about 40 to 45 kg seeds are needed to raise seedlings for 1 ha, whereas for fine grain varieties like Ratna, Prasad, Saket-4, etc., 30 to 35 kg seeds are enough. Do not burn FYM or leaf litter for nursery bed preparation. This is a common practice which needs to be halted.

Stage 2: **Transplanting of seedlings:** When seedlings are at 4–5 leaf stage and about 15–20 cm tall, they are ready for transplanting. Maintain 5–10 cm water level for two days prior to uprooting. The optimum age of seedlings for transplantation is 2 weeks after sowing. Transplanting older or bigger seedlings causes poor tillering and early flowering, resulting in lower yield. Transplant 2–3 seedlings per hill, at 25 x 25 cm distance, under normal conditions. Seedlings 45 days-old need to be transplanted with 5–6 seedlings per hill. In alkaline soils, 45 days-old seedlings establish better than 25 days old ones.
In each case, transplant seedlings at 2–3 cm depth. Do not plant seedlings deeper than 2–3 cm, as deeper planting delays and inhibits tillering.

Stage 3: **Primary tillers development:** This stage extends from the appearance of the first tiller until the maximum tiller number is reached. Tillers emerge from the axiliary buds of the nodes and displace the leaf as they grow and develop. This seedling shows the position of the two primary tillers with respect to the main culm and its leaves.

Nursery Preparation

Transplanting of Seedling

Primary Tillers Development

[2] This section has been taken and adapted from: D. Kumar and Y. S. Shivay (2008), Definitional Glossary of Agricultural terms, Volume II, I. K. International Publishing house Pvt. Ltd. New Delhi.

Stage 4: **Secondary tillers development:** After emerging, the primary tillers give rise to secondary tillers. This occurs about 30 days after transplanting. The plant is now increasing in length and tillering very actively. Here is a field with plants at the early tillering stage. Note the tiller size and canopy development due to increased leafing and tiller development.

Stage 5: **Active vegetative stage:** Besides numerous primary and secondary tillers, new tertiary tillers arise from the secondary tillers as the plant grows longer and larger. By this stage, the tillers have multiplied to the point that it is difficult to pick out the main stem. Tillers continuously develop as the plant enters the next stage which is stem elongation.

Stage 6: **Stem elongation and flag leaf stage:** This stage may begin before panicle initiation or it may occur during the latter part of the tillering stage. The tillers continue to increase in number and height, with no appreciable senescence of leaves noticeable. Ground cover and canopy formation by the growing plants have advanced. Growth duration is significantly related to stem elongation. Stem elongation is more in varieties with longer growth duration. In this respect, rice varieties can be categorized into two groups: the short-duration varieties which mature in 105-120 days and the long-duration varieties which mature in 150 days.

Secondary Tillers Development

Active Vegetative Stage

Stem Elongation & Flag leaf Stage

Stage 7: **Booting/ Panicle emergence:** The initiation of the panicle primordium at the tip of the growing shoot marks the start of the reproductive phase. The panicle primordium becomes visible to the naked eye about 10 days after initiation. At this stage, 3 leaves will still emerge before the panicle emergence. In short-duration varieties, the panicle becomes visible as a white feathery cone 1.0-1.5 mm long. It occurs first in the main culm and then in tillers where it emerges in uneven pattern. It can be seen by dissecting the stem. As the panicle continues to develop, the spikelets become distinguishable. The young panicle increases in size and its upward extension inside the flag leaf sheath causes the leaf sheath bulge. This bulging of the flag leaf sheath is called booting.

Booting is most likely to occur first in the main culm. At booting, senescence (aging and dying) of leaves and nonbearing tillers are noticeable at the base of the plant.

Stage 8: **Heading:** It's also known as panicle exertion stage. Heading is marked by the emergence of the panicle tip from the flag leaf sheath. The panicle continues to emerge until it partially or completely protrudes from the sheath.

Stage 9: **Flowering:** It begins when anthers protrude from the spikelet and then fertilization takes place. At flowering, the florets open, the anthers protrude from the flower glumes because of stamen elongation, and the pollen is shed. The florets then close. The pollen falls on the pistil, thereby fertilizing the egg. The pistil is the feathery structure through which the pollen tube of the germinating pollen (round, dark structures in this illustration) will extend into the ovary.

Flowering occurs a day after heading. Generally, the florets open in the morning. It takes about 7 days for all spikelets in a panicle to open. At flowering, 3-5 leaves are still active. The tillers of this rice plant have been separated at the start of flowering and grouped into bearing and nonbearing tillers.

Stage 10: **Milk grain stage:** In this stage, the grain has begun to fill with a milky material. The grain starts to fill with a white, milky liquid, which can be squeezed out by pressing the grain between the fingers.

Stage 11: **Dough grain stage:** During this stage, the milky portion of the grain first turns into a soft dough and later into a hard dough. The grains in the panicle begin to change from green to yellow. Senescence of tillers and leaves is noticeable. The field starts to look yellowish. As the panicle turns yellow, the last two remaining leaves of each tiller begin to dry at the tips.

Stage 12: **Mature grain stage:** The individual grain is mature, fully developed, hard, and has turned yellow. The upper leaves are now drying rapidly although the leaves of some varieties remain green. A considerable amount of dead leaves accumulate at the base of the plant.

Stage 13: **Harvesting:** The whole grain is hard and ready for harvest. This stage is reached at approximately 20 to 22 percent moisture.

Milk Grain Stage

Dough Grain Stage

Mature Grain Stage

Harvesting

3. Period of Sowing

The normal time for sowing of paddy in Sakri block is from first fortnight of June and traditionally transplanted one month after sowing with little or no use of organic manure. The recommendation is provided for paddy cultivation for Sakri block of Dhule district. Table 1 below indicated that various varieties (including indigenous varieties) along with duration, yield potential and varietal specification that are suitable for paddy cultivation.

Table 1: Local and recommended Paddy varieties suitable for cultivation along with duration and potential yield.

Sr. No.	Variety	Days to Maturity	Potential Yield (q/ha)	Grain size	Specifications
1	Khushabu (Daftari-9)	110-125	40 - 42	Long	High yield and aromatic variety, Mature crop height 90-95 cm, non lodging, non shattering, moderate tillering
2	Indrayani	130-140	40 - 45	Medium	Aromatic, high Demand, Best market rate.
3	Suruchi	110-120	40 - 45	Medium	Hybrid variety, short duration, high yield, comparatively low water requirement
4	Masuri	130-140	35 - 40	Small	Hybrid variety, good market demand and rate.
5	Madhu-mati	115-125	30 - 35	Medium	Aromatic, high Demand, Best market rate.
6	US 312	115-120	40 - 42	Medium	Hybrid variety, good market demand and rate.
7	Shital	130-140	38 - 40	Long	Hybrid variety, high yield
8	Rupali	115-120	40 - 45	Small	Hybrid variety, short duration, high yield
9	Menaka	120-130	35 - 37	Medium	Hybrid variety, high yield
10	Arise 6444	120-130	38 - 40	Medium	Hybrid variety, high yield
11	Kolam	100-110	28 - 30	Medium	Local variety, low water requirement, low duration, high domestic demand, low yield
12	Bhovadya	100-110	15 - 17	Medium	Local variety, low water requirement, low duration, high domestic demand, red grain colour, low yield
13	Chiman sal	110-120	18 - 20	Small	Local variety, low water requirement, low duration, high domestic demand, low yield
14	Sukavel	120-130	12 - 15	Medium	Local variety, high domestic demand, low yield

General Points to Remember

- Nutrient should be apply based on soil test report
- Nitrogenous fertilizer should be apply in split doses to increase nitrogen use efficiency
- Incorporate green leaves of Glyricidia @ 3 tons per hectare at the time of puddling
- The green manure crops like Dhaincha, Sun hemp should be grown on main field after receiving fist summer shower in the month of May
- Incorporate FYM/ compost @ 10 t/ha along with basal dose of fertilizers at the time of puddling or last harrowing
- Use of Blast tolerant varieties (IR - 64, IR - 36, Jaya) if possible in the region
- The green manure crops should be incorporate in the soil before flowering
- 500 sq. m nursery is sufficient for transplanting of one ha area by SRI method

Weather specific crop advisories for Paddy

Standard Meteorological Week number: 23 (4 June to 10 June)

SMW	T max (^{0}c)	T min (^{0}c)	Relative Humidity (%)	Wind Speed (Km/hr)	Rainfall(mm)
23	37.59	25.74	50.90	11.35	31.66

Anticipated weather likely to be observed	**Existing crop stage**	**Recommendations based on likely effects of anticipated weather changes**
Normal weather conditions	**Nursery**	➢ Prepare raised bed of 1 x 1 x 0.1 m ➢ Nursery of 500 sq.m is sufficient for transplanting of one hectare area ➢ Incorporate compost @ 3 kg and vermicompost @1 kg per sq.m. of nursery bed ➢ Seed treatment with 3% brine solution to avoid the infestation of Paddy blast ➢ Seed treatment with *Azotobacter* Culture @ 25 g and *Pseudomonas fluorescens* talc @ 10g/kg of seeds ➢ Sowing of seeds @ 5 kg/ha in SRI method and 40 kg/ha for other methods
Rainfall received >15 mm in one or two consecutive days		
Rainfall received >30 mm in one or two consecutive days		
Sufficient rainfall followed by clear sky and high RH (>75%)		➢ Prepare raised bed of 1 x 1 x 0.1 m ➢ Give pre sowing irrigation and then sowing should be done
Light rainfall, intermediate cloudy sky/ moderate humidity		
No rains, cloudy sky, low RH		
No rains, cloudy sky, high RH (>75%)		
No rainfall, hot and dry winds during day time		

Standard Meteorological Week number: 24 (11 June to 17 June)

SMW	T max (^{0}c)	T min (^{0}c)	Relative Humidity (%)	Wind Speed (Km/hr)	Rainfall(mm)
24	35.76	25.25	62.45	12.38	69.89

Anticipated weather likely to be observed	**Existing crop stage**	**Recommendations based on likely effects of anticipated weather changes**
Normal weather conditions	**Nursery/Seedling**	Monitor crop for the infestation of **Stem Borer, bacterial blight and blast**
Rainfall received >15 mm in one or two consecutive		➢ Avoid continuous water stagnation in the field ➢ Remove weeds on the bunds because weeds are alternate host for pests and diseases ➢ Apply urea @ 1 kg/R to nursery bed at 10 DAS
Rainfall received >30 mm in one or two consecutive days		➢ Spray *Amritpani* @150 ml/15 lit. of water ➢ Apply urea @ 1 kg/R to nursery bed at 10 DAS ➢ Remove the weeds on the bunds because weeds are alternate host for pests and diseases
Sufficient rainfall followed by clear sky and high RH (>75%)		
Light rainfall, intermediate cloudy sky/ moderate humidity		
No rains, cloudy sky, low RH		
No rains, cloudy sky, high RH (>75%)		
No rainfall, hot and dry winds during day time		

Standard Meteorological Week number: 25 and 26 (18 June to 01 July)

SMW	T max (^{0}c)	T min (^{0}c)	Relative Humidity (%)	Wind Speed (Km/hr)	Rainfall(mm)
25	34.63	25.07	68.26	13.08	64.63
26	33.33	24.64	72.08	12.00	138.40

Anticipated weather likely to be observed	**Existing crop stage**	**Recommendations based on likely effects of anticipated weather changes**
Normal weather conditions	**Transplanting**	➢ Puddling should be done to prepare muddy soil condition ➢ Incorporate green leaves of glyricidia @ 3 tons per ha at the time of puddling ➢ Uproot the paddy seedling and clip off the leaf tips of seedling to destroy the egg masses of paddy stem borer ➢ Seedling should be treated with *Amritpani* for five to ten minutes ➢ Transplanting of seedling should be done in straight direction at spacing of 25 x 25 cm^2 ➢ Transplant two seedlings/ hill ➢ Placement of urea-DAP briquettes @ 170 kg/ha in the middle of the square of four plants at 6 to 8 cm depth **OR** ➢ Apply 40% N and full dose of P and K at the time of sowing i.e. 40:50:50 NPK kg/ha ➢ Grow rice cultivar Pusa Basamati-1 as trap crop along the field boundary
Rainfall received >15 mm in one or two consecutive days		
Rainfall received >30 mm in one or two consecutive days		
Sufficient rainfall followed by clear sky and high RH (>75%)		
Light rainfall, intermediate cloudy sky/ moderate humidity		➢ Transplanting should be avoided
No rains, cloudy sky, low RH		
No rains, cloudy sky, high RH (>75%)		
No rainfall, hot and dry winds during day time		

Standard Meteorological Week number: 27 and 28 (02 July to 15 July)

SMW	T max (^{0}c)	T min (^{0}c)	Relative Humidity (%)	Wind Speed (Km/hr)	Rainfall(mm)
27	32.09	24.30	77.36	11.61	132.71
28	31.47	24.10	78.73	11.91	131.14

Anticipated weather likely to be observed	**Existing crop stage**	**Recommendations based on likely effects of anticipated weather changes**
Normal weather conditions	**Primary tiller development**	Monitor crop for the infestation of **Stem Borer, Gall midge Fly, case worm, leaf folder, armyworm, Brown plant hopper, bacterial blight and blast** ➢ Avoid continuous water stagnation in the field ➢ Setup light traps @ 5/ha ➢ Weeding should be done by cycle/rotary hoe at 15 DAT ➢ Apply *Jeevamrit* @ 200 lit./acre
Rainfall received >15 mm in one or two consecutive days		
Rainfall received >30 mm in one or two consecutive days		
Sufficient rainfall followed by clear sky and high RH (>75%)		
Light rainfall, intermediate cloudy sky/ moderate humidity		➢ Setup light traps @ 5/ha ➢ Weeding should be done by cycle/rotary hoe at 15 DAT ➢ Apply *Jeevamrit* @ 200 lit./acre ➢ Spray *Amritpani* @ 150 ml/15 lit. of water
No rains, cloudy sky, low RH		
No rains, cloudy sky, high RH (>75%)		
No rainfall, hot and dry winds during day time		

Standard Meteorological Week number: 29 and 30 (16 July to 29 July)

SMW	T max (^{0}c)	T min (^{0}c)	Relative Humidity (%)	Wind Speed (Km/hr)	Rainfall(mm)
29	30.63	23.97	81.30	13.79	155.53
30	30.22	23.71	83.88	10.28	212.71

Anticipated weather likely to be observed	**Existing crop stage**	**Recommendations based on likely effects of anticipated weather changes**
Normal weather conditions	**Secondary tillage development**	Monitor crop for the infestation of **Stem Borer, Gall midge Fly, case worm, leaf folder, armyworm, Brown plant hopper, bacterial blight and blast** ➢ If urea DAP briquette was not applied at the time of transplanting, then top dressing of 40 kg N/ha. ➢ Spray *Amritpani* @ 150 ml/15 lit. of water
Rainfall received >15 mm in one or two consecutive days		
Rainfall received >30 mm in one or two consecutive days		➢ Remove excess water from the field ➢ Avoid top dressing of nitrogenous fertilizers ➢ Collect and destroy insect trapped in pheromone and light trap
Sufficient rainfall followed by clear sky and high RH (>75%)		➢ Recommendations same as normal weather conditions ➢ Spray *Amritpani* @150 ml /15 lit. of water ➢ Apply *Jeevamrit* @ 200 lit./acre
Light rainfall, intermediate cloudy sky/ moderate humidity		
No rains, cloudy sky, low RH		
No rains, cloudy sky, high RH (>75%)		
No rainfall, hot and dry winds during day time		

Standard Meteorological Week number: 31 and 32 (30 July to 12 Aug)

SMW	T max (^{0}c)	T min (^{0}c)	Relative Humidity (%)	Wind Speed (Km/hr)	Rainfall(mm)
31	29.88	23.52	85.49	12.06	187.16
32	29.47	23.30	86.90	12.99	162.21

Anticipated weather likely to be observed	**Existing crop stage**	**Recommendations based on likely effects of anticipated weather changes**
Normal weather conditions	**Stem elongation and flag leaf stage**	Monitor crop for incidence of **yellow stem bore, brown plant hopper, cut-worm, leaf folder, sheath rot, stem rot, blight and blast** ➢ Apply jeevamrit @ 200 lit./acre ➢ Hand weeding should be done to keep weeds free plot ➢ Drained out excess water from field ➢ Spray vermi wash @500 ml/15 lits of water
Rainfall received >15 mm in one or two consecutive days		
Rainfall received >30 mm in one or two consecutive days		➢ Drained out excess water from field ➢ Remove weed on bunds as they are alternate host for pests & diseases ➢ Spray vermi wash @500 ml/15 lits of water
Sufficient rainfall followed by clear sky and high RH (>75%)		➢ Recommendations same as normal weather conditions ➢ Remove weed/grasses on bunds because these are alternate host for pests and diseases ➢ Monitor crop for pest and diseases as indicated above
Light rainfall, intermediate cloudy sky/ moderate humidity		
No rains, cloudy sky, low RH		
No rains, cloudy sky, high RH (>75%)		
No rainfall, hot and dry winds during day time		

Standard Meteorological Week number: 33 and 34 (13 Aug to 26 Aug)

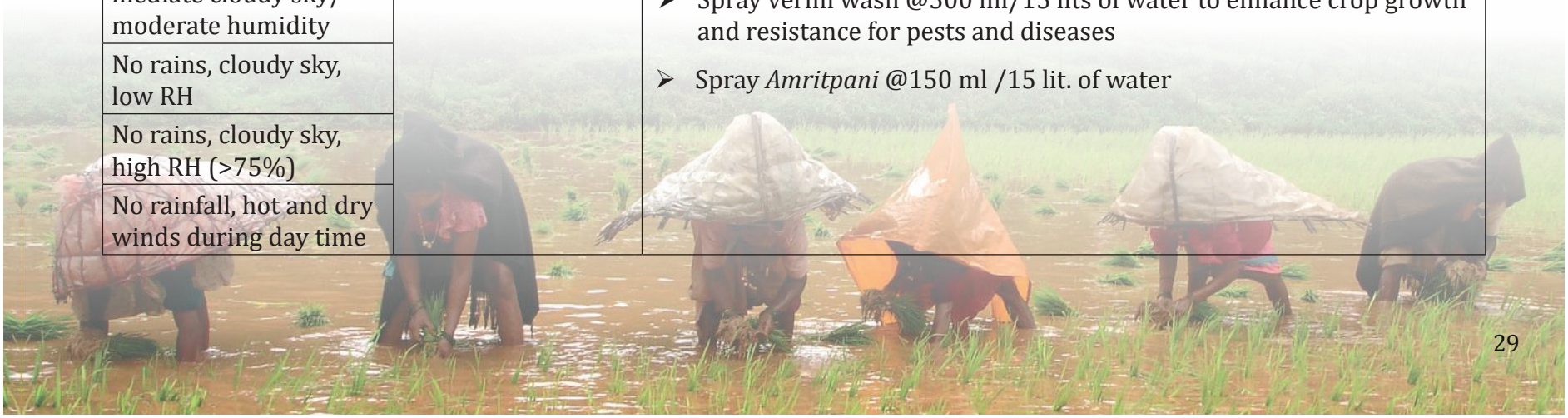
SMW	T max (^{0}c)	T min (^{0}c)	Relative Humidity (%)	Wind Speed (Km/hr)	Rainfall(mm)
33	30.04	23.31	86.12	12.85	109.79
34	30.10	23.18	85.47	8.86	92.05

Anticipated weather likely to be observed	**Existing crop stage**	**Recommendations based on likely effects of anticipated weather changes**
Normal weather conditions	**Panicle initiation**	Monitor crop for incidence of **yellow stem bore, brown plant hopper, cutworm, leaf folder, sheath rot, stem rot, blight and blast** ➢ Drained out excess water from field ➢ Collect and destroy insect trapped in pheromone and light traps ➢ Spray *Amritpani* @150 ml /15 lit. of water ➢ Spray 1% Urea +2% DAP +1%KCL at panicle initiation
Rainfall received >15 mm in one or two consecutive days		
Rainfall received >30 mm in one or two consecutive days		
Sufficient rainfall followed by clear sky and high RH (>75%)		➢ Apply *Jeevamrit* @ 200 lit./acre ➢ Monitor crop for incidence of above mentioned pests and diseases ➢ Collect and destroy insect trapped in pheromone and light traps ➢ Spray 1% Urea +2% DAP +1%KCL at panicle initiation
Light rainfall, intermediate cloudy sky/ moderate humidity		
No rains, cloudy sky, low RH		
No rains, cloudy sky, high RH (>75%)		
No rainfall, hot and dry winds during day time		

Standard Meteorological Week number: 35 and 36 (27 Aug to 9 Sep)

SMW	T max (^{0}c)	T min (^{0}c)	Relative Humidity (%)	Wind Speed (Km/hr)	Rainfall(mm)
35	30.14	23.01	85.65	8.45	85.08
36	30.81	22.91	84.63	11.71	99.00

Anticipated weather likely to be observed	**Existing crop stage**	**Recommendations based on likely effects of anticipated weather changes**
Normal weather conditions	**Flowering**	Monitor crop for incidence of **yellow stem bore, brown plant hopper, cutworm, leaf folder, sheath rot, stem rot, blight and blast** ➢ If urea DAP briquette was not applied at the time of transplanting, then top dressing of 20 kg N/ha. ➢ Spray vermi wash @500 ml/15 lits of water to enhance crop growth and resistance for pests and diseases
Rainfall received >15 mm in one or two consecutive days		
Rainfall received >30 mm in one or two consecutive days		
Sufficient rainfall followed by clear sky and high RH (>75%)		➢ If urea DAP briquette was not applied at the time of transplanting, then top dressing of 20 kg N/ha. ➢ Collect and destroy insects trapped in pheromone and light traps ➢ Spray vermi wash @500 ml/15 lits of water to enhance crop growth and resistance for pests and diseases ➢ Spray *Amritpani* @150 ml /15 lit. of water
Light rainfall, intermediate cloudy sky/ moderate humidity		
No rains, cloudy sky, low RH		
No rains, cloudy sky, high RH (>75%)		
No rainfall, hot and dry winds during day time		



Standard Meteorological Week number: 37, 38 and 39 (10 Sep to 30 Sept)

SMW	T max (^{0}c)	T min (^{0}c)	Relative Humidity (%)	Wind Speed (Km/hr)	Rainfall(mm)
37	31.57	22.72	81.92	11.39	66.40
38	32.37	22.77	79.17	10.78	62.39
39	33.07	22.75	76.02	17.21	70.25

Anticipated weather likely to be observed	**Crop stage**	**Recommendations based on likely effects of anticipated weather changes**
Normal weather condition	**Milk grain stage/Dough grain stage**	Monitor crop for incidence of **brown plant hopper, cutworm, leaf folder, Gundhi bug, sheath rot, blight, Udbatta and blast** ➢ Collect and destroy insects trapped in pheromone and light traps
Rainfall received >15 mm in one or two consecutive days		
Rainfall received >30 mm in one or two consecutive days		
Sufficient rainfall followed by clear sky and high RH (>75%)		➢ If Irrigation facility is available then provide protective irrigation ➢ Monitor crop for pests and diseases incidence as indicated above
Light rainfall, intermediate cloudy sky/ moderate humidity		
No rains, cloudy sky, low RH		
No rains, cloudy sky, high RH (>75%)		
No rainfall, hot and dry winds during day time		

Standard Meteorological Week number: 40 (01 Oct to 07 Oct)

SMW	T max (^{0}c)	T min (^{0}c)	Relative Humidity (%)	Wind Speed (Km/hr)	Rainfall(mm)
40	34.14	22.29	69.43	6.07	41.45

Anticipated weather likely to be observed	Crop stage	Recommendations based on likely effects of anticipated weather changes
Normal weather condition	**Mature grain stage**	➢ Monitor crop for incidence of **Gundhi bug, rat, birds and false smut** ➢ Drain out excess water from field
Rainfall received >15 mm in one or two consecutive days		
Rainfall received >30 mm in one or two consecutive days		
Sufficient rainfall followed by clear sky and high RH (>75%)		
Light rainfall, intermediate cloudy sky/ moderate humidity		
No rains, cloudy sky, low RH		
No rains, cloudy sky, high RH (>75%)		
No rainfall, hot and dry winds during day time		

Standard Meteorological Week number: 41 and 42 (08 Oct to 21 Oct)

SMW	T max (^{0}c)	T min (^{0}c)	Relative Humidity (%)	Wind Speed (Km/hr)	Rainfall(mm)
41	34.70	21.55	62.88	7.25	23.05
42	34.72	20.18	54.39	6.09	9.33

Anticipated weather likely to be observed	Crop stage	Recommendations based on likely effects of anticipated weather changes
Normal weather condition	**Mature grain stage and Harvesting**	➢ Monitor the field for maturity symptoms for harvesting of crop: 1. De-hull a few grains from the upper portion of the matured panicles and observe their translucence and firmness 2. Grains, when ready for harvest, are clear and firm 3. Moisture content of grains is less than 20% 4. About 80% panicles are straw colored and grains in lower portion of panicle are in hard dough stage 5. At least five hills are to be studied at maturity ➢ Separate out Smut-affected panicles to avoid contamination ➢ Harvest close to ground level to destroy pests hibernated in the internodes/stubbles. This will also expose the insects to birds thus helping in natural biocontrol of insect pests ➢ Harvesting should be done at clear weather conditions ➢ Protect the harvested produce from rains and keep it in a safe and dry place
Rainfall received >15 mm in one or two consecutive days		
Rainfall received >30 mm in one or two consecutive days		
Sufficient rainfall followed by clear sky and high RH (>75%)		
Light rainfall, intermediate cloudy sky/ moderate humidity		
No rains, cloudy sky, low RH		
No rains, cloudy sky, high RH (>75%)		
No rainfall, hot and dry winds during day time		

Pest & Disease








Annexure I - Pests:

Sr. No	Pest	Crop stage	Actions to be Undertaken
1	**Yellow Stem Borer-** *Scirpophaga incertulas* 	Seedlings, Primary tiller development, Secondary tiller development, Stem elongation and flag leaf stage, panicle emergence, Heading, Flowering	• Destruction of stubble after harvest to reduce the carry-over to next crop. Harvesting the plant close to the ground • Clipping off tip of seedling before transplanting reduces carry-over of eggs from nursery to main field as the eggs of stem borers are laid near the tip of the leaf • Avoid continuous water stagnation in the field • Pull out and destroy affected seedlings • Set up light traps @ 2 to 3/ ha to attract and kill the moths • Release the egg parasitoid, *Trichogramma japonicum* two times at 15 days interval @ 50,000-1,00,000 adult/ha • Apply Fipronil 0.3% GR @ 25 kg/ha ***ETL for Stem Borer: two egg mass/m²***
2	**Gall Midge Fly-** *Orseolia oryzae* 	Seedlings, Primary tiller development, Secondary tiller development,	• Use recommended dose of potassium • Setup light trap @ 2 to 3 /ha • Spray 5% NSKE • Apply Fipronil 0.3% GR @ 25 kg/ha **OR** Quinolphos 5G @ 15 kg/ha ***ETL for Gall midge fly: 1 gall fly/m² or 10% Silver shoot***

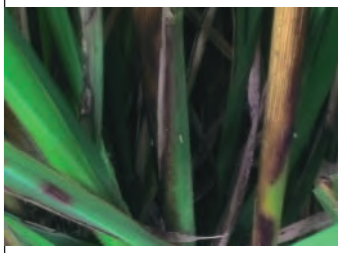
3	**Brown Plant Hoppers-** *Laodelphax striatellus* 	Primary tiller development, Secondary tiller development, Stem elongation and flag leaf stage panicle emergence Heading, Flowering	• Avoid excess use of nitrogenous fertilizers • Apply nitrogenous fertilizer in spilt doses • Drain out water in case of heavy infestation • Set up of light traps @ 5/ ha to attract and kill hoppers • Spray 5% NSKE **OR** Neemastra • Spray *Dashaparni ark* @ 150 ml/ 15 lit. of water • Spray Phosalone 35% EC @ 20 ml/15 lit. of water **OR** Imidacloprid 70% WG @ 15 g mixed in 15 lit. of water ***ETL for Brown Plant Hoppers 10-15 Hoppers/Plant***
4	**Case Worm-** *Nymphula depunctalis* 	Primary tiller development, Secondary tiller development, Panicle initiation	• Do not allow standing water in the field • Mechanical killing of the larvae of case worm by straining running water from the field • Spray *Dashaparni ark* @ 150 ml/ 15 lit. of water • Spray Chlorpyriphos 20% EC @ 25 ml/15 lit. of water ***ETL for Case Worm: 2 fully damaged leaves/hill***
5	**Swarming Caterpillar -** *Spodoptera mauritia* and Cut Worm- *Spodoptera litura* 	Primary tiller development, Secondary tiller development, Panicle initiation	• Avoid close planting and excess use of nitrogenous fertilizers • Weed out the graminacious weed hosts from the field • Spray 5%NSKE **OR** Spray *Dashaparni* ark @ 150 ml/ 15 lit. of water • Spray Chlorpyriphos 20% EC @ 25 ml/15 lit. of water ***ETL for Swarming Caterpillar: 1 damaged tiller/hill or 2 larvae/ m^2***

6	**Leaf Folder-** *Cnaphalocrocis medinalis* 	Primary tiller development, Stem elongation and flag leaf stage, Panicle emergence	• Avoid excess use of nitrogenous fertilizers • Release the egg parasitoid, *Trichogramma chilonis* two times at 15 days interval @ 50,000-1,00,000 adults/ha • Spray 5% NSKE **OR** Spray *Dashaparni ark* @ 150 ml/ 15 lit. of water • Spray Chlorpyriphos 20% EC @ 25 ml/15 lit. of water **OR** Phosalone 35% EC @ 20-25ml/15 lit. of water ***ETL for Leaf Folder: 2 fully damaged leaves/hill***
7	**Green Leaf Hopper-** *Nephotettix virescens* 	Secondary tiller development Active vegetative stage	• Avoid excess use of nitrogenous fertilizers • Weed out the graminacious weed hosts from the field • Set up light traps @ 5 / ha to attract and kill the moths • Set up yellow sticky traps @ 25/ha to attract and kill hoppers • Spray 5%NSKE • Spray Acephate 75% SP @ 20-25ml/15 lit. of water **OR** Imidacloprid 17.8% SL @ 3 ml / 15 lit. of water **OR** Chlorpyriphos 20% EC @ 30 ml/15 lit. of water ***ETL for Green Leaf Hoppers: 10-20 Hoppers / Plant***

8	**Gundhi Bug-** *Leptocorisa oratorius* 	Flowering, Milk grain stage, Dough grain stage	• Spray 5%NSKE • Spray Acephate 75% SP @ 20-25ml/15 lit. of water ***ETL for Gundhi Bug: 1 to 2 Bugs/ Plant***
9	**Rat-** *Rattus rattus, Bandicota bengalensis etc.* 	Milk grain stage, Dough Grain Stage	• Wildcats, snakes, and birds are predators of rice field rats; protect them • In severe damage conditions, use Zinc Phosphide as poison baits in the field for the control of rats
10	**Bird** 	Milk grain stage, Dough grain Stage	• Scaring devices and chemical repellents can also be used in the field

Annexure II - Diseases:

Sr. No	Disease	Existing crop stage	Remedial Measures
1	Blast- *Pyricularia oryzae* 	Seedlings, Primary tiller development, Secondary tiller development, Stem elongation and flag leaf stage, Panicle emergence, flowering	• Use healthy and disease resistant varieties like Indrayani, Panvel-1 for blast • Early planting to reduce disease intensity • Control grasses and other weeds as these are alternate host for the pathogens • Burn and destroy diseased plant debris and stubble • Avoid excessive depth application of irrigation water • Spray Carpropamid 27.8% SC @ 15 ml/15 lit. of water **OR** Isoprothiolane 40% EC @ 37ml/15 lit. of water **OR** Propiconazole 25% EC @ 15 ml/15 lit. of water **OR** Carbendazim 50% WP @ 15 g /15 lit. of water ***ETL for Blast: 3-5 lesions/leaf***
2.	Bacterial Blight- *Xanthomonas oryzae* 	Seedlings, Primary tiller development, Secondary tiller development, Stem elongation and flag leaf stage, Panicle emergence, flowering	• Use healthy and disease resistant varieties like Karjat-1, Radhanagri-185 for blight • Early planting to reduce disease intensity • Avoid clipping of seedlings during transplanting • Control grasses and other weeds as these are alternate host for the pathogens • Balanced fertilization and avoid excess N application • Burn and destroy diseased plant debris and stubble • Avoid excessive depth application of irrigation water • Spray Streptomycin 100 to 150 ppm solution @early root stage ***ETL for Bacterial blight is 2-3 infected leaves/m^2***

3.	Sheath Rot- *Sarocladium oryzae* Sheath Blight- *Rhizoctonia solani* 	Primary tiller development	• Foliar spray of *Pseudomonas fluorescens* talc formulation @ 30g/ 15 lit. of water • Spray Mancozeb 75% WP @ 35 gm/15 lit. of water **OR** Propiconazole 25% EC @ 15 ml/15 lit. of water **OR** Thiophanate methyl 70% WP @ 15 g/15 lit. of water ***ETL for Sheath Blight: Lesions of 5-6 mm in length & 2-3 infected plants/ m²*** ***ETL for Sheath Rot :Lesions of 2-3 mm on sheath & 3-5 infected plants/ m²***
4.	Stem Rot- *Sclerotium oryzae* 	Secondary tiller development	• Drain out the excess water from field • Spray Validamycin 3% L @ 30ml/15 lit. of water **OR** Benomyl 50% WP @15g/15 lit. of water **OR** Carbendazim 50% WP @ 15g/15 lit. of water
5.	Udbatta Disease- *Balansia oryzae* 	Milk grain stage, Dough grain stage	• Treat seeds with Benlate @ 2.5g / kg of seed • Remove and destroy the diseased panicles • Spray Copper hydroxide @ 30 g/15 lit. of water
6.	False Smut- *Ustilaginoidea virens* 	Milk grain stage, Dough grain stage	• Remove and destroy the diseased infected panicles • Spray Propiconazole 25% EC @ 15 ml/15 lit. of water **OR** Chlorothalonil 75% WP @ 30 ml/15 lit. of water

References

http://www.knowledgebank.irri.org/extension/vegetative-phase/stage-2-tillering.html
http://baegrisk.ddns.uark.edu/test/Books/PDF/chapter1sl3.pdf
http://agmarknet.nic.in/amrscheme/punerice041.htm
http://www.agritech.tnau.ac.in/expert_system/paddy/Botany.html
http://farmer.gov.in/imagedefault/pestanddiseasescrops/pestanddiseasesofrice.pdf
http://www.sri-india.net/documents/IPM_IDM_SRI_Paddy.pdf
http://www.rkmp.co.in/sites/default/files/eis_states/stemborer%20larva%20in%20stubbles.JPG
http://www.cpsskerala.in/OPC/images/crops/Rice/Pest/145.jpg
http://www.rkmp.co.in/sites/default/files/eis_states/BPH.jpg
http://www.cpsskerala.in/OPC/images/crops/Rice/Pest/116.jpg
http://arentolib.blogspot.in/2013/09/rice-swarming-caterpillar.html
http://www.nbair.res.in/insectpests/images/Cnaphalocrocis-medinalis2.jpg
https://www.cropscience.bayer.com/-/media/bcs-inter/ws_globalportal/crop-compendium/pests/nephotettix-virescens/nephotett-vires1-600-jpg.jpg
http://www.nbair.res.in/insectpests/images/Leptocorisa-oratorius10.jpg
http://www.knowledgebank.irri.org/images/stories/bacterial-leaf-blight-3.JPG
http://www.knowledgebank.irri.org/smta/images/stories/Module2/newdiseasesimages/blast/leaf%20blast.jpg
https://plantix.net/plant-disease/images/hd/PEAT_20170221_165853_4deb3ef0-4793-4e07-9bfc-03a9b22bd4f6.jpg
http://www.knowledgebank.irri.org/images/stories/stem-rot.jpg
https://innspubnet.files.wordpress.com/2017/01/false-smut-black-spores.jpg?w=691&h=503

Chickpea

Weather Based Management of Chickpea (*Cicer arientinum* L.) Cultivation

1. Introduction

Chickpea is one of the major pulse crop cultivated and consumed in India, is also known as Bengal gram or Gram or Chana. Chickpea is a major and cheap source of protein compared to animal protein. Gram in India is cultivated in Madhya Pradesh, Rajasthan, Uttar Pradesh, Maharashtra and Haryana. The area under gram cultivation has gone down very sharply in the last twenty-five years in these states. Chickpea seed contain about 20-22 % of protein. In India, chickpea accounts for about 45% of total pulses produced in the country. India is the major producing country for chickpea, contributing for over 75% of total production in the world. Chickpea is an important pulse crop predominantly grown in *rabi* season in the month of mid-October to first fortnight of November and harvested in the month of January to February. It is best suited to areas having moderate rainfall of 600-900 mm per annum. The average air temperature varies from 25 to 30°C for good crop growth. Nights must be warmer with 20 to 25°C temperature favorable for crop growth and development. Excessive rains soon after sowing or at flowering stage are harmful for the crop. Severe cold is injurious and is very harmful. Chickpea crop have ability to fix atmospheric nitrogen (N_2) in soil through symbiotic association with *rhizobium*. Nodules present on roots of chickpea absorb atmospheric nitrogen gas and *rhizobium* converts the N_2 into ammonia.

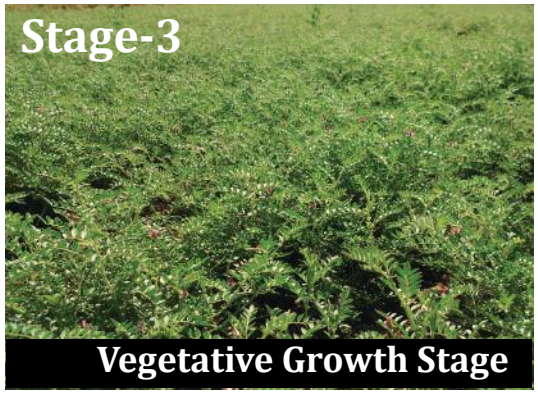
2. Phenological Growth Stages of Chickpea[3]

Since crop management recommendations depend crucially upon the vegetative growth stage of a crop, we give below an overview of the different growth stages of Chickpea.

Stage 1: Germination:
Chickpea seeds germinate at an optimum temperature (28-33°C) and moisture level in about 5-6 days. Germination begins with absorption of moisture and swelling of the seed.

Stage 2: Seedling:
The chickpea stem is erect, branched, viscous, hairy, terete, herbaceous, green, and solid. The branches are usually quadrangular, ribbed and green.

Stage 3: Vegetative growth stages:
During vegetative phase i.e., during first 30 days, rouging is attempted based on plant characters like height of plant, leaf shape, size, surface characteristics like hairy or plain leaves, stem colour (green / pink / blotched). Plants showing symptoms of root rot, wilt and sterility mosaic are also removed. Early flowering types (may short duration) can also be removed.



[3] The above material has been adapted from the following source: http://www.ndsu.edu/pubweb/pulse-info/growthstages-pdf/ChickpeaGrowth-Stages.pdf

Stage 4: **Reproductive Growth Stages**

The self-pollinated plant produces 1 – 2 flowers at the tip of axillary branches. Pods may contain up to 3 seeds, and are oval in shape; and at maturity, the plants and pods turn yellow to tan.

Stages of reproductive growth:

Early bloom, one open flower on the plant

Full bloom, most flowers are open

Early pod visible

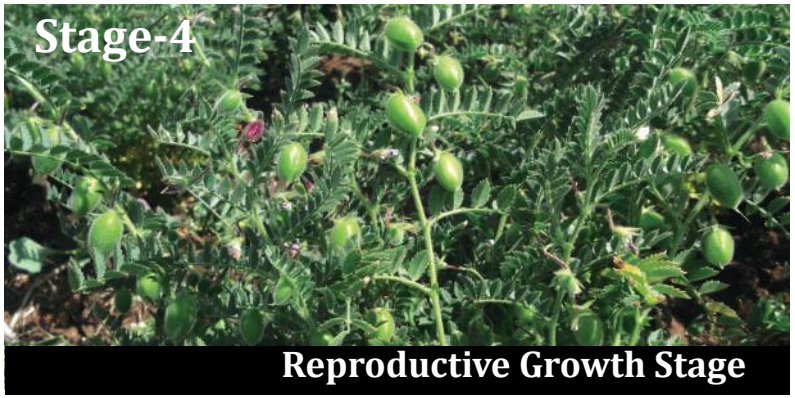
Flat pod, pod has reached its full size and is largely flat.

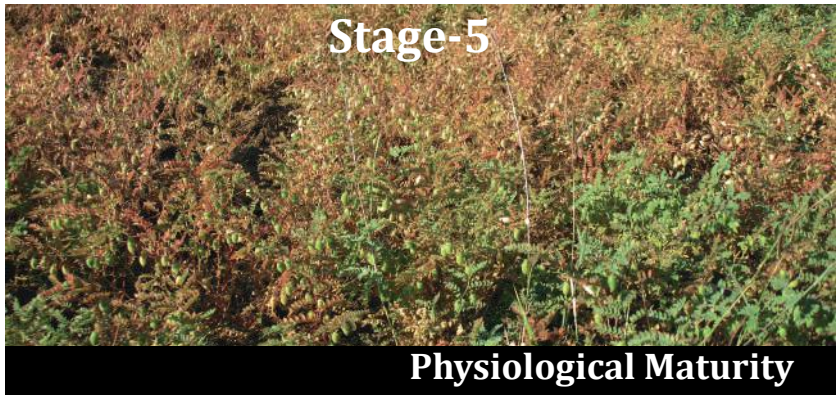
Early seed, seed in any single pod fill the pod cavity

Full seed, all seeds fill the pod cavity which is rounded

Stage 5: **Physiological maturity**

The leaves start yellowing and 50% of the pods have turned yellow. 90% of pods on the plant are golden-brown





3. Chickpea Cultivation in Sakri Block[4]

Chickpea is an important *rabi* crop mainly sown in month of October -November and harvested in January-February. Sometimes, it is also grown as a regularly or partially irrigated crop. Sowing of chickpea is done after harvest of kharif crop on residual soil moisture. Sowing is done by traditional method i.e. sowing behind the plough. Farmers of this area apply farm yard manure in summer season at the time of land preparation and very little or no chemical fertilizers were applied for chickpea crop.

Table: 1. Varieties of chickpea suitable for cultivation in Sakri Block

Sr. No.	Variety	Ave. yield (Q/ha)	Days to maturity	Special characters
1	Bharati (ICCV-10)	18-20	95-100	Resistant to fusarium wilt & dry root rot
2	Sweta (ICCV-2)	12-13	80-90	Resistant to wilt & Botrytis grey mould
3	Vijay (Phule G-81- 1-1)	19-21	105-110	Resistant to wilt and tolerant to terminal moisture stress
4	Vishal (Phule G- 87207)	20	110-115	Resistant to wilt, Tolerant to pod borer and Early maturing
5	Hirwa Chaffa (AKGS-1)	15-17	105-110	Green seeded
6	Pusa-391 (BG-391)	17-18	110-120	Moderately resistant to wilt & root rot. Bold seeded.
7	Virat (Kabuli)	20	108-118	Resistant to wilt
8	Digvijay	19	105-110	Resistant to fusarium wilt
9	Akash (BDNG- 797)	15-16	100-102	Resistant to wilt and tolerant to pod borer
10	JAKI 9218	18-20	93-115	Resistant to fusarium wilt, root rot and collar rot
11	Phule G 0517	18	105-110	Tolerant to fusarium wilt and 59.4g/100 seed weight
12	PKV harita (AKG 9303-12)	12-18	106-110	Bold seeded, tolerant to wilt and drought, useful for culinary purpose

[4] http://dpd.gov.in/VARIETIES-Web%20site.pdf

4. General Points to be kept in mind

- Seeds should be purchased from the authorized agencies/dealers. It should be free from diseases and pests.
- Seed should be treated with *Trichoderma* @5 g/kg of seed to control fungal diseases like fusarium wilt followed by *Rhizobium* and PSB each @25g/kg of seeds
- Crop rotation with cereals crop should be followed to control soil born disease
- Maintain optimum plant population i.e. 3.33 lakh/ ha.
- For better germination of seed, sowing should be done at 10 cm depth for rainfed chickpea and 5 cm depth for irrigated chickpea
- Remove the tips of the young branches (nipping) of gram to enhance branching
- Provide protective irrigation at branching, flowering (40-45 DAS) and pod formation (65-70 DAS)
- Intercropping with Linseed helps to minimize the incidence of alternaria blight.
- Grow trap crops like marigold to control nematode, mustard and coriander for aphids and castor for pod borer
- Incorporate Neem Leaf manure @ 500 kg/ha Or Neem seed manure @ 100 kg/ha to the soils having major problems of white grub and termite

5. Pest and disease management

Details about control measures at various stages of crop growth are furnished in Annexure I (pest) and Annexure II (Disease). Remedial actions may be initiated accordingly.

Weather specific crop advisories for Chickpea

Standard Meteorological Week number: 40 and 41 (01 October to 14 October)

SMW	T max (^{0}c)	T min (^{0}c)	Relative Humidity (%)	Wind Speed (Km/hr)	Rain-fall(mm)
40	34.14	22.29	69.43	6.07	41.45
41	34.70	21.55	62.88	7.25	23.05

Anticipated weather likely to be observed	Existing crop stage	Recommendations based on likely effects of anticipated weather changes
Normal weather conditions	Land preparations	➢ For irrigated crop, one shallow ploughing followed by two harrowing should be done after harvest of *kharif* crop to prepare good seed bed ➢ Land preparation should be done at optimum soil moisture ➢ In-situ moisture conservation should be done
Rainfall received >15 mm in one or two consecutive days		
Rainfall received >30 mm in one or two consecutive days		➢ Avoid land preparation ➢ Drained out excess water from field
Sufficient rainfall followed by clear sky and high RH (>75%)		➢ One shallow ploughing followed by one harrowing should be done after harvest of kharif crop to prepare good seed bed ➢ Land preparation should be done at optimum soil moisture condition ➢ In-situ moisture conservation should be done
Light rainfall, intermediate cloudy sky/ moderate humidity		
No rains, cloudy sky, low RH		
No rains, cloudy sky, high RH (>75%)		
No rainfall, hot and dry winds during day time		

Standard Meteorological Week number: 42 (15 October to 21 October)

SMW	T max (^{0}c)	T min (^{0}c)	Relative Humidity (%)	Wind Speed (Km/hr)	Rainfall (mm)
42	34.12	20.18	54.39	6.09	9.33

Anticipated weather likely to be observed	Existing crop stage	Recommendations based on likely effects of anticipated weather changes
Normal weather conditions	Sowing	➢ Seed treatment with *Trichoderma viride* @ 5 g/kg of seed to control fungal diseases as fusarium wilt followed by *Rhizobium* and PSB each of @ 25g/ kg of seeds ➢ Sowing should be done by drilling or sowing behind the plough method at 30 cm space between the rows. Similarly for dibbling method, it should be done at plant spacing of 45 x 15 cm^2 ➢ If organic manure was not applied in the kharif season, then incorporate FYM/Compost @ 5 tons/ha in the soil before last harrowing ➢ Seed rate required for dibbling method is about 60 kg/ha while drilling method is about 80-100 kg/ha. ➢ Grow Coriander and Mustard as trap crop in main field to attract pest ➢ Apply recommended dose of fertilizer i.e. 25 kg N and 50 kg P_2O_5 per ha at the time of sowing
Rainfall received >15 mm in one or two consecutive		
Rainfall received >30 mm in one or two consecutive days		➢ Drained out excess water from field ➢ Sowing should be done at optimum soil moisture (field capacity)
Sufficient rainfall followed by clear sky and high RH (>75%)		➢ Sowing should be done on residual soil moisture ➢ Recommendations same as normal weather condition ➢ If irrigation facilities are available, then provide light irrigation after sowing
Light rainfall, intermediate cloudy sky/ moderate humidity		
No rains, cloudy sky, low RH		
No rains, cloudy sky, high RH (>75%)		
No rainfall, hot and dry winds during day time		

Standard Meteorological Week number: 43 (22 October to 28 October)

SMW	T max (^{0}c)	T min (^{0}c)	Relative Humidity (%)	Wind Speed (Km/hr)	Rainfall(mm)
43	34.23	18.56	47.22	7.02	7.33

Anticipated weather likely to be observed	**Existing crop stage**	**Recommendations based on likely effects of anticipated weather changes**
Normal weather conditions	**Germination/ Seedling**	Monitor crop for the incidence of **wilt, termite and white grub** ➢ Observe crop for optimum germination ➢ Gap filling should be done to maintain optimum plant population ➢ Rouge out disease infected plant and destroy it **Details about control measures at various stages of the crop growth are furnished in Annexure I (Pest) and Annexure II (Diseases). Control measures may be followed accordingly**
Rainfall received >15 mm in one or two consecutive days		
Rainfall received >30 mm in one or two consecutive days		➢ Remove excess water from field
Sufficient rainfall followed by clear sky and high RH (>75%)		➢ Recommendations same as normal weather condition
Light rainfall, intermediate cloudy sky/ moderate humidity		
No rains, cloudy sky, low RH		
No rains, cloudy sky, high RH (>75%)		
No rainfall, hot and dry winds during day time		

Standard Meteorological Week number: 44 to 46 (29 October to 18 November)

SMW	T max (^{0}c)	T min (^{0}c)	Relative Humidity (%)	Wind Speed (Km/hr)	Rainfall(mm)
44	34.07	17.80	44.15	8.25	1.75
45	33.35	17.29	45.60	6.89	3.36
46	32.67	16.90	46.66	9.19	7.13

Anticipated weather likely to be observed	**Existing crop stage**	**Recommendations based on likely effects of anticipated weather changes**
Normal weather conditions	**Seedling/ Branching**	Monitor crop for the incidence of **cutworm, semilooper, termite, white grub and wilt** ➢ Rouge out off type, disease infected plants and destroy it ➢ Spray *Amritpani* @ 150 ml/15 lit. of water ➢ Hoeing and weeding should be done to keep weed free plot during early growth stage of the crop ➢ Install pheromone traps @ 5/ha. It should be install 15 cm above the crop canopy ➢ Install bird perches @ 50/ha ➢ Nipping should be done to enhance branching
Rainfall received >15 mm in one or two consecutive days		
Rainfall received >30 mm in one or two consecutive days		➢ Drained out excess water from field ➢ Recommendations same as normal weather condition
Sufficient rainfall followed by clear sky and high RH (>75%)		➢ Apply *Jeevamrut* @ 200 lit./ha along with irrigation ➢ Foliar spray of 1% KNO_3 to reduce moisture stress ➢ Recommendations same as normal weather condition
Light rainfall, intermediate cloudy sky/ moderate humidity		
No rains, cloudy sky, low RH		
No rains, cloudy sky, high RH (>75%)		
No rainfall, hot and dry winds during day time		

Standard Meteorological Week number: 47 and 48 (19 November to 02 December)

SMW	T max (^{0}c)	T min (^{0}c)	Relative Humidity (%)	Wind Speed (Km/hr)	Rainfall(mm)
47	31.88	15.73	43.38	4.62	1.87
48	31.44	15.08	41.45	4.72	0.61

Anticipated weather likely to be observed	**Existing crop stage**	**Recommendations based on likely effects of anticipated weather changes**
Normal weather conditions	**Branching/ pre flowering**	Monitor crop for the incidence **Leaf eating caterpillar, cutworm, semilooper, wilt and root rot** ➢ Rouge out off type, disease infected plant and destroy it ➢ Install light trap @ 5 per ha to monitor the pest population
Rainfall received >15 mm in one or two consecutive days		
Rainfall received >30 mm in one or two consecutive days		➢ Drained out excess water from field ➢ Recommendations same as normal weather condition ➢ Collect and destroy insect trapped in pheromone and light traps
Sufficient rainfall followed by clear sky and high RH (>75%)		➢ Recommendations same as normal weather condition ➢ Spray *Amritpani* @ 150 ml/15 lit. of water ➢ Hoeing should be done to check the evaporation losses from the soil ➢ Collect and destroy insect trapped in pheromone and light trap
Light rainfall, intermediate cloudy sky/ moderate humidity		
No rains, cloudy sky, low RH		
No rains, cloudy sky, high RH (>75%)		
No rainfall, hot and dry winds during day time		

Standard Meteorological Week number: 49 and 50 (03 December 16 December)

SMW	T max (^{0}c)	T min (^{0}c)	Relative Humidity (%)	Wind Speed (Km/hr)	Rainfall(mm)
49	30.87	14.28	40.11	4.00	0.52
50	29.92	13.28	39.36	7.77	0.59

Anticipated weather likely to be observed	Existing crop stage	Recommendations based on likely effects of anticipated weather changes
Normal weather conditions	**Flowering**	Monitor crop for the incidence of **Gram Pod borer, Alternaria Blight and Botrytis gray mold**
Rainfall received >15 mm in one or two consecutive days		➢ Spray 00:52:34 @ 50 g + Nitrobenzene @ 30 ml/15 lit of water
Rainfall received >30 mm in one or two consecutive days		➢ Remove excess water from the field
Sufficient rainfall followed by clear sky and high RH (>75%)		➢ Collect and destroy insects trapped in pheromone trap ➢ Spray *Amritpani* @ 150 ml per 15 lit. of water ➢ Recommendation same as normal weather conditions
Light rainfall, intermediate cloudy sky/ moderate humidity		
No rains, cloudy sky, low RH		➢ Collect and destroy insects trapped in pheromone trap ➢ Apply *Jeevamrut* @ 200 lit./ha along with protective irrigation ➢ Foliar spray of 1% KNO_3 to reduce moisture stress ➢ Recommendations same as normal weather condition
No rains, cloudy sky, high RH (>75%)		
No rainfall, hot and dry winds during day time		

Standard Meteorological Week number: 51 and 52 (17 December to December 31)

SMW	T max (^{0}c)	T min (^{0}c)	Relative Humidity (%)	Wind Speed (Km/hr)	Rainfall(mm)
51	29.85	12.69	38.31	11.49	0.79
52	29.08	12.42	39.59	15.58	0.04

Anticipated weather likely to be observed	**Existing crop stage**	**Recommendations based on likely effects of anticipated weather changes**
Normal weather conditions	**Pod formation**	Monitor the crop for incidence of **Gram Pod borer, Alternaria Blight and Botrytis gray mold** ➢ Spray 00:52:34 @ 50 g + Nitrobenzene @ 30 ml/15 lit of water ➢ Collect and destroy insects trapped in pheromone and light traps
Rainfall received >15 mm in one or two consecutive days		
Rainfall received >30 mm in one or two consecutive days		➢ Drained out excess water from field to avoid continuous water stagnation
Sufficient rainfall followed by clear sky and high RH (>75%)		➢ Provide protective irrigation and along with apply *Jeevmrit* @ 200 lit. per acre ➢ Recommendations same as normal weather conditions ➢ Mechanical collection and destruction of gram pod borer attracted on trap crop ➢ Spray vermiwash @500ml / 15 lit. of water
Light rainfall, intermediate cloudy sky/ moderate humidity		
No rains, cloudy sky, low RH		
No rains, cloudy sky, high RH (>75%)		
No rainfall, hot and dry winds during day time		

Standard Meteorological Week number: 1 and 2 (01 January to 14 January)

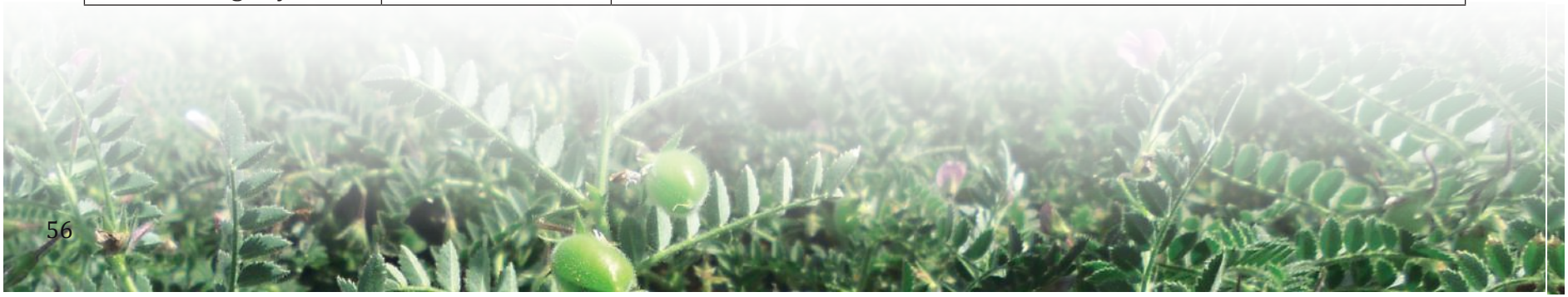
SMW	T max (^{0}c)	T min (^{0}c)	Relative Humidity (%)	Wind Speed (Km/hr)	Rainfall(mm)
1	28.60	12.33	39.62	8.81	0.07
2	28.95	12.08	39.55	6.93	0.26

Anticipated weather likely to be observed	**Existing crop stage**	**Recommendations based on likely effects of anticipated weather changes**
Normal weather conditions	**Pod Development**	Monitor the crop for incidence of **Gram Pod borer, Alternaria Blight and Botrytis gray mold**
Rainfall received >15 mm in one or two consecutive days		➢ Collect and destroy insects trapped in pheromone and light traps
Rainfall received >30 mm in one or two consecutive days		➢ Drained out excess water from field to avoid continuous water stagnation
Sufficient rainfall followed by clear sky and high RH (>75%)		➢ Provide light irrigation for proper seed development ➢ Collect and destroy insects trapped in pheromone and light traps
Light rainfall, intermediate cloudy sky/ moderate humidity		
No rains, cloudy sky, low RH		
No rains, cloudy sky, high RH (>75%)		Recommendation same as normal weather conditions
No rainfall, hot and dry winds during day time		

Standard Meteorological Week number: 3 (15 January to 21 January)

SMW	T max (^{0}c)	T min (^{0}c)	Relative Humidity (%)	Wind Speed (Km/hr)	Rainfall(mm)
3	28.6	13.2	37.11	4.4	0

Anticipated weather likely to be observed	**Crop stage**	**Recommendations based on likely effects of anticipated weather changes**
Normal weather condition	**Grain hardening**	➢ Monitor the crop for hardening of grains, leaves become yellow, pods become dry and yellow in colour
Rainfall received >15 mm in one or two consecutive days		
Rainfall received >30 mm in one or two consecutive days		
Sufficient rainfall followed by clear sky and high RH (>75%)		
Light rainfall, intermediate cloudy sky/ moderate humidity		
No rains, cloudy sky, low RH		
No rains, cloudy sky, high RH (>75%)		
No rainfall, hot and dry winds during day time		



Standard Meteorological Week number: 4 (21January to 28 January)

SMW	T max (^{0}c)	T min (^{0}c)	Relative Humidity (%)	Wind Speed (Km/hr)	Rainfall(mm)
4	27.8	11.6	33.87	4.3	2.4

Anticipated weather likely to be observed	Crop stage	Recommendations based on likely effects of anticipated weather changes
Normal weather condition	**Physiological maturity and harvesting**	**Monitor the field for signs of harvesting** 1. The crop should be harvested when leaves start senesce and shedding 2. The leaves become yellowish and 50% of the pods turn to yellow 3. Harvest at minimum of 13-14% moisture content in seed to minimize mechanical damage to the seed 4. Seed should be stored at approximate 13% moisture content 5. Kept grain at a temperature below 30^{0}C 6. Grading should be done to remove split, damaged and small seeds
Rainfall received >15 mm in one or two consecutive days		➢ No action should be carried out by farmer, harvesting and threshing should be done in clear weather condition
Rainfall received >30 mm in one or two consecutive days		
Sufficient rainfall followed by clear sky and high RH (>75%)		➢ Recommendations same as normal weather condition
Light rainfall, intermediate cloudy sky/ moderate humidity		
No rains, cloudy sky, low RH		
No rains, cloudy sky, high RH (>75%)		
No rainfall, hot and dry winds during day time		

Pests & Diseases

Annexure I: Pests

Sr. No	Pest	Crop Stage	Remedial measures
1	**Cut Worm :** *Agrotis ipsilon* 	Seedling, branching	• Deep summer ploughing • Do not grow Tomato and Lady Finger in nearby field • Grow marigold as trap crop on field bunds • Intercropping with sorghum / Linseed / Mustard to reduce infestation • Spray 5% NSKE • Spray *Dashparni ark* @ 150 ml /15 lit. of water • Spray chlorpyriphos 20% EC @ 30 ml/15 lit of water **OR** Spray quinalphos 25% EC @ 30 ml/15 lit of water
2	**Termites:** *Odontoermes obesus* 	Seedling, branching	• Provide pre sowing irrigation and frequent intercultural operations • Field sanitation, timely disposal of crop residues and undecomposed plant parts • Destroy the termitoria and kill the queen • Incorporate Neem Leaf manure @ 500 kg/ha at the time of sowing **OR** Apply Neem seed manure @ 100 kg/ha at the time of sowing • Spray chlorpyriphos 20% EC @ 30 ml/15 lit of water

3	**White Grub:** *Phyllophaga spp* 	Seedling, branching	• Incorporate Neem Leaf manure @ 500 kg/ha **OR** Apply Neem seed manure @ 100 kg/ha • Soil application of *Metarhizium anisopliae* @ 250 ml mixed in 100 kg of FYM and apply for 1 acre • Spray chlorpyriphos 20% EC @ 30 ml/15 lit of water
4	**Gram Pod borer:** *Helicoverpa armigera* 	Branching, flowering, pod formation and pod development	• Hand picking of grown up larvae • Install bird perches @ 50/ha • Install pheromone traps @ 5/ha • Spray 5% NSKE **OR** Neemastra • Spray *Dashparni ark* @ 150 ml /15 lit. of water • Spray Dichlorvos 76% EC @ 625 ml/ha **OR** Lamba Cyhalothrin 5% EC @15 ml/15 lit. of water **ETL for Gram pod borer : 2 to 3 eggs/ 10 plants Or 9-10 eggs/ m^2**
5	**Semilooper:** *Autographa nigrisigna* 	Seedling, branching,	• Avoid closer plant spacing • Collect and destroy larvae & adults to the extent possible • Setting of light traps @5/ha to kill moth • Install bird perches @ 50/ha • Releasing *Trichogramma chlionis* at one week intervals @ 1.5 lakh/ha for four times • Spray 5% NSKE • Spray *Dashparni ark* @ 150 ml /15 lit. of water • Lamba Cyhalothrin 5% EC @15 ml/15 lit. of water **ETL for Semilooper: 10% affected parts**

Annexure II: Diseases

Sr. No	Disease	Crop stage	Remedial measures
1	**Wilt:** *Fusarium oxysporum* 	Germination, Seedling, branching, flowering	• Deep summer ploughing • Crop rotation with cereal crops preferably with sorghum • Seed treatment with *trichoderma viridi* @ 5 g/kg of seed • Use disease resistant varieties • Avoid sowing when temperatures are high • Uproot the affected plants & destroy it immediately • Spot drenching with Carbendazim 50% WP@15g/15lit of water
2	**Root rot:** *Rhizoctonia bataticola* 	Branching, flowering	• Deep ploughing in summer • Remove the affected plants from the field • Cultivation of chickpea in raised bed and furrow method • Germinating and young seedlings should be protect from high temperatures • Seed treatment with Thiram75% WP @ 1.5g/ kg of seed • Spot drenching with Carbendazim 50% WP @ 15 g/15 lit of water

3	**Alternaria Blight :** *Alternaria alternata* 	Flowering, pod formation, pod development	• Intercropping with linseed • Avoid excessive vegetative growth • Avoid excessive irrigation to crop • Spray Mancozeb 75% WP @ 45 g/15 lit of water **OR** Spray Carbendazim 50% WP @ 15 g/15 lit of water
4	**Botrytis gray mold:** *Botrytis cinerea* 	Flowering, pod formation, pod development	• Intercropping with linseed • Avoid excessive vegetative growth • Spray Captan 50% WP @ 15 g/15 lit of water Spray Carbendazim 50% WP @ 15 g/15 lit of water **OR** Spray Mancozeb 75% WP @ 45 g/15 lit of water

References

Kay, D.E. 1979. Chickpea (Cicer ahetinum). Pages 48-71 in Crop and Product Digest. No. 3, Food Legumes. London, UK: Tropical Product Institute.
Arakeri, H.R., Chalam, G.V., Satyanarayana, P., and Donahne, L. 1959. Soil management in India. Bombay, India: Asia Publishing House.
Moolani, M.K., and Chandra, S. 1970. Gram cultivation in Haryana. Bulletin of the Haryana Agr icul tural University, Hisar, India. 15 pp.
Saxena, M.C. 1987. Agronomy of chickpea. Pages 2 0 7 - 2 3 2 in The chickpea (Saxena, M.C, and Singh, K.B., eds.) . Wallingford, Oxon, UK: CAB International.
Chickpea Botany and Production Practices compiled by Faujdar Singh and B. Diwakar International Crops Research Institute for the Semi-Arid Tropics

http://agropedia.iitk.ac.in/content/seed-and-sowing-chickpea
http://www.fallowsolutions.com.au/Portals/8/Gallery/CropGrowthChart/CHICKPEAS.pdf
http://www.ndsu.edu/pubweb/pulse-info/growthstages-pdf/ChickpeaGrowthStages.pdf
http://www.icrisat.org/tropicallegumesII/pdfs/ChickpeaManual_full.pdf
http://icrisat.agropedia.in/content/land-preparation-chickpea
https://hort.uwex.edu/files/2014/11/white-grub.jpg
http://agropedia.iitk.ac.in/sites/default/files/Helico.JPG
http://www.westernexterminator.com/blog/wp-content/uploads/2016/01/termite-colony.jpg
https://news.uns.purdue.edu/images/2013/krupke-cutworm.jpg
http://www.croppro.com.au/crop_disease_manual/media/Figure%205_2%20Typical%20leaf%20lesions%20caused%20by%20Ascochyta_1000.jpg
http://www.croppro.com.au/crop_disease_manual/media/Figure%205_16%20Seed%20discolouratiion%20caused%20by%20Botrytis%20infection_1000.jpg
http://pbt.padil.gov.au/pbt/files/uall/pbt34-symptom-03.jpg
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Preparation of organic and plant based formulations from locally available material for enhancing plant growth, soil health and controlling pests and diseases

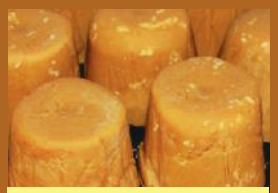
AMRITPANI


Fresh cow dung- 1 kg


Cow urine- 1 lit.


Neem leaves- 1 kg


Chickpea floor – 1 kg


Jaggary – 100 gm


Water- 10 lit.

a) Material Required

i. Fresh cow dung- 1 kg
ii. Cow urine- 1 liter
iii. Green neem leaves- 1 kg
iv. Gram flour – 1 kg
v. Jaggary – 100 gm
vi. Water- 10 liter

b) Method of Preparation

Take a 15 liter capacity plastic bucket. Then mix all the above material into the bucket then stir it vigorously with a wooden stick; cover with lid when well mixed and store in shade for 10 days. The mixture should be stirred with a wooden stick clockwise and anti-clockwise for 5-10 minutes every day, in the morning and evening. After 10 days, the mixture should be filtered with a cotton cloth. It is then ready for spraying.

c) Dose of Application

Mix 100 ml. of Amritpani in 10 liters of water and spray it on all crops at vegetative stage.

d) Advantages

i. It is use full for all crops at vegetative growth stage
ii. It is beneficial for pest control
iii. It gives lustre to the crop/ grains and increases yield

DASHPARNI ARK


Ghaneri Leaves


Jatropha Leaves


Custard apple Leaves


Neem Leaves


Rui Leaves


Cow dung


Water

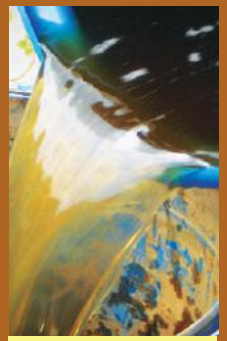

Kanheri Leaves


Karanj Leaves


Papaya Leaves


Nirgudi Leaves


Gulvel Leaves


Cow Urine

a) Material Required

I. Neem Leaves – 5 kg
ii. Ghaneri (*Lantana camera*) – 2 kg
iii. Karanj Leaves – 2 kg
iv. Kanheri Leaves – 2 kg
v. Jatropha or Castor Leaves – 2 kg
vi. Gulvel Leaves – 2 kg
vii. Custard apple Leaves – 3 kg
viii. Rui Leaves – 2 kg
ix. Papaya Leaves – 2 kg
x. Nirgudi Leaves -2 kg
xi. Cow Urine/ Gomutra – 5 liter
xii. Cow dung (Deshi) – 2 kg
xiii. Water 170 liters

b) Method of Preparation

Mix all above content in a plastic container or barrel. The mixture should be stirred with a wooden stick clockwise and anti-clockwise for 5-10 minutes every day, in the morning and evening. Keep it for 30 days in shade. After one month, separate the ark through a sieve the arck is ready for spraying as a bio-pesticide.

c) Dose of Application

Recommended dose for spraying is 125-150 ml of Dashparni ark per 15 liters of water.

d) Advantages

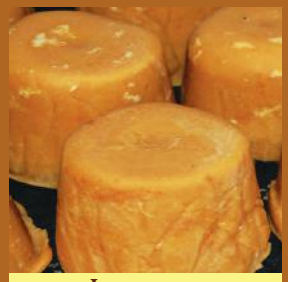
1. It is a natural bio-pesticide.
2. It controls all sucking insect pest on all crops.
3 It is a low cost pesticide as compared to chemical pesticides.
4. It does not cause harmful effects to crops, pollinators and natural predators, the environment and humans being.

JEEVAMRUT

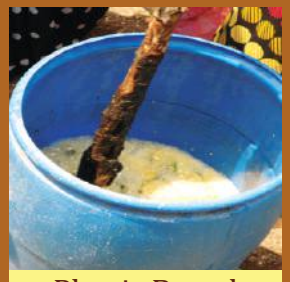

Fresh Cowdung


Cow Urine


Gram Flour


Jaggery


Water


Plastic Barrel

a) Material Required

I. Fresh cowdung - 10 kg
ii. Cow urine - 10 liters
iii. Gram flour - 2 kg
iv. Jaggery - 1 kg
v. 200 litre plastic barrel
vi. Water - 180 liters

b) Method of Preparation

Take 200 litres capacity plastic barrel; then mix all above material into the barrel and add 180 litres of water in it. Then stir with a wooden stick clockwise and anti-clock wise in the morning and evening for 5 to 10 minutes for 6 days. It should be kept in the shade. After 6 days, Jeevamrit is ready for application to the soil.

c) Dose of Application

Apply 200 liters of Jeevamrit slurry for 1 acre area as a soil application at the time of irrigation.

d) Advantages

I. It is low cost and useful for all crops
ii. It increases the vegetative growth of the plant
iii. Microbial activity is increased in the soil which helps to maintain and improve soil health
iv. It also helps to maintain C:N ratio of the soil

5% NEEM ARK (NSKE)

Neem Seeds

Plastic Bucket

Plastic Drum

a) Material Required

I. Dried neem seeds 5 kg

ii. Plastic bucket

iii. Plastic drum

b) Method of Preparation

Take 5 kg of dried neem seeds, grind them into powder, mix in 10 liters of water and keep it for 24 hrs. Then separate out the resultant by filtering through cotton cloth and add 90 liter of water to make final volume of 100 liters, The Neem Ark is now ready for spraying.

c) Dose of Application

Spray 5% NSKE directly without making any further dilution

d) Advantages

1 It controls Aphid, Jassids, Leaf eating Caterpillars, Thrips in all crops

2. It also controls white grub and nematodes in all crops

3. It's a low cost natural bio-pesticide and does not cause harmful effects to crops, pollinators and natural predators, the environment and humans being

About us

Watershed Organisation Trust, (WOTR) is a non profit that engages at the intersection of practice, knowledge and policy across scales and in collaboration with stakeholders from across sectors. Headquatered in Pune, WOTR has supported and carried out developmental work in over 4122 villages across 7 states of India.

WOTR assists rural communities to assess their vulnerability to climate and non climatic risks. It organizes them in a socially and gender inclusive manner to help themselves out of poverty by regenerating their ecosystems in a holistic and integrated manner, conserving and optimising resource use. especially water and undertaking climate smart sustainable livelihoods.

WOTR has set up the WOTR Centre for Resilience Studies (W-CReS) through which it undertakes applied research and closely engages with institutions and governance actors so that insights and good practices derived from ground experience contribute to shaping enabling policies and effective programs. With a view to upscaling successful interventions, WOTR develops pedagogies for implementation and organizes a variety of knowledge sharing and capacity building events for stakeholders across the civil society, developmental and governance spaces, from India and other countries.

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