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BLACK RICE: A POTENTIAL SOURCE OF NUTRIENT RICH FOOD

Kasanaboina Krishna[1], Marsukola Aparna[2], G. Babith raj goud[3], S. Praveen Kumar[4], and M. Bharath Kumar[5]

[1]Ph.D Research Scholar, ICRISAT, Department of Genetics and Plant Breeding, PJTSAU, College of Agriculture, Rajendranagar. Hyderabad, 500030, Telangana, India.

[2]Department of Soil Science and Agriculture Chemistry, PJTSAU, College of Agriculture, Polasa, Jagtial, 505529, Telangana, India.

[3]Department of Crop Physilogy, PJTSAU, College of Agriculture, Rajendranagar. Hyderabad, 500030, Telangana, India.

[4]Ph.D Research Scholar, Department of Seed Science and Technology, PJTSAU, College of Agriculture, Rajendranagar. Hyderabad, 500030, Telangana, India.

[5]Ph.D Research Scholar, IIRR, Department of Genetics and Plant Breeding, PJTSAU, College of Agriculture, Rajendranagar. Hyderabad, 500030, Telangana, India.

Author Email: kasanaboinakrishna@gmail.com

Introduction

More than half of the world's population relies on rice (*Oryza sativa* L.) as a primary source of nutrition. With a production of 117.47 million tonnes, it is grown on an area of 43.86 million hectares in India (DAC&FW, 2019-20). In comparison to white and red rice, black rice (*Oryza sativa* L. indica) has substantially higher levels of anthocyanin pigments in the aleurone layer, giving it a violet or dark purple hue. (Hou *et al.,* 2013). Black rice has nearly six times the antioxidant activity of white rice, 8.16 percent more protein, and less fat (0.07 percent). Unlike other rice varieties, this one is gut-friendly, gluten-free, and has several medical benefits (Jha et al., 2017). In addition to vitamins including vitamin B1, vitamin B2, vitamin E, folic acid, and phenolic compounds, black rice also provides useful fats, dietary fibre, and important amino acids like lysine and tryptophan. When cooked, it becomes slightly sticky and has a little nutty flavour. It is low in calories and high in macro and micronutrients including iron, zinc, calcium, phosphorus, and selenium. Compared to other rice varieties black rice has a higher protein and nutritional content. Due to its many health advantages, it has recently gained popularity in the food, cosmetic, nutraceutical, and pharmaceutical industries. Compared to brown rice, black and red rice is more pest and insect resistant. Compared to dark fruits including blueberries, blackberries, dark grapes, and dark cherries, black rice contains higher levels of anthocyanins. As a result, it provides more antioxidants than blueberries (Kushwaha, 2016).

Nutritional compostion of different rice types

Today, a variety of rice varieties are available, with white rice being the most popular. Black rice is the variety with the most nutritional value out of all of them. A comparison of various rice varieties that have differing nutrient contents when measured against a 100 g serving of each kind (Table 1) (www.naturalnews.com).

Table 1: Nutritional compostion of different rice types

Polished white rice	6.8 proteins, 1.2 irons, 0.5 zinc, and 0.6 fibers
Brown rice	7.9 protein, 2.2 iron, 0.5 zinc, and 2.8 fiber
Purple rice	8.3 proteins, 3.9 irons, 2.2 zinc, and 1.4 fibers
Red rice	7.0 proteins, 5.5 irons, 3.3 zinc, and 2.0 fibers
Black rice	8.5 proteins, 3.5 irons, 0.0 zinc, and 4.9 fibers

Potential benefits of black rice

Similar to quinoa, black rice is a superfood that is full of nutrients. Due to its multi-nutritional quality, farmers can profit from a better market value and increased farm revenue, which will motivate them to cultivate it widely. Consuming black rice can lessen the demand for cereal with a high nutritional status. Due to its improved grain quality and greater market value, black rice is offered in the local market for higher rates (Rs 150–200/kg) (Borah et al., 2018). The high concentration of polyphenols, which can be separated into fractions and used as functional colourants or culinary components, gives it significant significance in the food sector. (Kushwaha, 2016) found that one-fourth cup uncooked black rice contains approximately (in daily recommended values) 160 kcal energy, 1.5 g of fat, 34 g of carbohydrate, 2 g of fiber, 7.5 g of protein, no saturated fat and cholesterol.

Pecularity of Black Rice

For its potential use in biomedical applications, black rice variants have been the focus of exploratory research. These dark-hued fruits, including acai berries, blues, blackberries, dark grapes, and dark cherries, all contain an antioxidant called anthocyanins, which is also present in this rice. The colour of black rice is therefore darker than that of other types of rice. The benefits of anthocyanins include improved memory, less inflammation, lower risk of developing cancer, and improved heart health. As much anthocyanins as blueberries in one tablespoon, if not more, are present in black rice. In place of other rices, this makes it a fantastic complement to the diet. Due to the absence of fibre, white rice digests quickly. Even if someone eats a lot of white rice, they will soon feel hungry again, which prompts them to nibble, which almost certainly results in weight gain. However, black rice takes longer to digest due to its high fibre content, making a guy feel hungry for longer. Due to the bran being left on the rice, this rice naturally contains a lot of iron, which gives it its deep purple colour. A study comparing the physicochemical characteristics of black rice and white rice varieties revealed that the former had more minerals, a faster rate of hydrolysis, and a lower blue value than the latter. This study highlighted the substantial variance in the physicochemical characteristics of the analysed black rice types). According to Frank et al. (2012), compared white and red rice, black rice displayed increased amounts of fatty acid methyl esters, free fatty acids, organic acids, and amino acids.

Some major uses of this rice are

- Anthocyanin pigment that is water soluble can be removed during cooking and utilised as a natural dye..
- It serves as an anti-aging agent in healthy diets and cosmetic products. (Kaneda *et al.,* 2006).
- Black rice, which has a high polyphenol content and may be utilised to produce wine, is a fantastic substrate. (Jha *et al.,* 2017).
- It is utilised to make bread, kheer, porridge, and black rice cakes. etc.
- Due to their longer culm length and durability, black rice straws are preferred as a thatching material.
- After threshing husk is used as livestock feed and also used in farmyard manure preparation.

Constraints in black rice production

In India, black rice is still not extensively used as a food. One of the reasons for black rice's low production is that its potential has not yet been fully realized. Its inherent negative characteristics, such as low yield, high photoinsensitivity, a longer vegetative phase, and tall stature that increases its loading, are the major causes of its unadoption among farmers. The inability of the general public to get nutrient-enriched black rice is caused by lower yield and higher cost.

Black Rice Cons, Side Effects and Negatives

Consuming black rice has no significant disadvantages. It provides long-lasting carbs that are nutrient-rich, low in fat, delicious, and adaptable. The benefits of antioxidant consumption may be exaggerated, which is the only troubling trending evidence. Contrary to popular belief, consuming antioxidants does not directly raise blood plasma antioxidant levels. According to recent studies, oxidative damage may still be modulated, although in various ways, by chemicals like anthocyanins. Anthocyanins, a type of plant flavonoid, are thought to function as signalling molecules that instruct specific cells in the body to change how certain genes are expressed. This is one of the more well-known theories about how plant flavonoids work.

Future aspects

In Order To Develop Desired Features In The Best Rice Varieties And Strengthen Sustainability By Protecting The Indigenous Black Rice Species, More Study Must Be Done On Black Rice.

- Malnutrition difficulties can be partially eliminated by making special rice (black rice, red rice, etc.) the main crop and raising public awareness. It can boost the variety's widespread adoption for cultivation purposes in various parts of world to generate variations with good agronomic and marketing qualities.
- Phenotype and genotype improvement are required to produce superior cultivars.
- For black rice to make up for its lengthy harvest period, output must be boosted. Therefore, it is essential to create cultivars that can produce a higher yield earlier.

Conclusion

Due to its high nutrient density, high fibre content, and abundant antioxidant content, black rice is a fantastic substitute for white and brown rice. Because it contributes to illness prevention and control in addition to providing nutrients, black rice is now viewed as a nutraceutical and functional food. Several studies suggested that black rice consumption may promote heart and liver health, weight loss, control of blood glucose level and lipid profile, prevention and control of inflammation and cancer. They also suggested that black rice consumption may reduce the risk of developing a number of diseases and illnesses.

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DESIGNER EGGS: A NEW DIRECTION IN CONTEMPORARY HEALTHCARE

Ashish Shivji Bhuva*
College of Agriculture, Anand Agricultural University, Jabugam- 391 155, Gujarat, India
Corresponding author**:** ashishshivji91@gmail.com

Introduction

Eggs are a natural source of life-sustaining chemicals that offer a very nutritious dietary source, including crucial nutrients for humans. Customers are driving the market for a new category of food with potential health benefits much beyond those that have previously been established since they are constantly looking for newer items. Egg is a well-liked food item in all cultures around the world because of its superior nutritious profile, low cost, and variety in meal preparation. They provide protein as a single food item. The body needs protein to create and repair bodily tissues. Many customers want products that are slightly unique in terms of quality, freshness, taste, colour, etc. Changing the old product is one strategy for marketing a new one. One of the most difficult issues the industry is dealing with is the sharp fall in egg consumption over the past 50 years, but because eggs have become more valuable source of protein in the post-World War I era, demand has grown. Designer eggs help to reduce this issue.



Design Eggs: Why they're needed and How to prepare them.

Hens have a special ability to deposit dietary lipid into the egg yolk, the hen egg is a possible source of unsaturated fatty acids. Drugs work to decrease cholesterol in eggs by either preventing the hen from synthesising cholesterol or by preventing the blood from carrying cholesterol to the developing yolk on the ovary. The FDA has not yet given the medications (Atorvastatin) commercial use approval, despite its potential to decrease cholesterol. Altering the fatty acid makeup of the yolk is another method for reducing the effects of cholesterol in eggs.

Making Designer Eggs: Techniques

Special feeding techniques have made it feasible to produce eggs with even lower cholesterol and saturated fat levels as well as significantly higher levels of carotenoids, vitamins, minerals, antibodies, and even bioactive peptides. causing the hen to undergo metabolic

changes that may lead to the creation of substances that ultimately end up in the egg. Modify membrane transport properties to make it easier to carry substances into the egg**.**

Modification in Nutritional Profile with Designer Eggs

- Omega-3 enriched egg
- Low cholesterol eggs
- Immunomodulating egg production
- Mineral enriched designer eggs
- Herbal enriched designer eggs
- Pigment enriched designer eggs
- Antioxidants enriched eggs
- Vitamin enriched designer eggs.

Eggs with Omega-3s: The PUFA family includes omega-3 fatty acids, often known as n-3 fatty acids. Eggs are a poor source of n-3 fatty acids but contain a high proportion of n-6 PUFA. Eggs with a high yolk omega-3 fatty acid concentration are produced by feeding diets rich in omega-3 fatty acids. Two varieties of omega-3 exist:

1. Marine Type: PUFA, DHA, and EPA,which are more frequently found in deep-sea fish from cold waters, fish oil, and marine algae

2. Terrestrial type: 3 PUFA, LNA, which can be found in flaxseed, walnuts, spinach, and mustard greens as well as soybean and canola oils.

Reduced Cholesterol Levels

The health risks of high cholesterol are well known to the chicken business. Safety and product quality have always been the top priorities. The general public can purchase designer eggs with lower levels of cholesterol and saturated fat. By including herbal supplements like basil (tulsi), bay leaves, citrus pulp (nirangenin), grape seed pulp, guar gum, roselle seeds, spirulina, tomato pomace (lycopene), and many other herbs in chicken diets, the cholesterol levels in the chicken and yolk fat can be lowered by 10–25%.

Mineral and Vitamin Enriched Designer Eggs

Mineral Enriched Eggs

- Chromium Enriched Eggs
- Selenium Enriched Eggs
- Iron Enriched Eggs
- Zinc Enriched Eggs
- Iodine and Manganese Enriched Eggs

Vitamin Enriched Eggs

- Vitamin A Enriched Eggs
- Vitamin B_{12} Enriched Eggs
- Vitamin D Enriched Eggs

- Folic Acid and Biotin Enriched Eggs
- Vitamin K Enriched Eggs

Herbal Enriched Designer Eggs

To boost hen performance and generate herbal-enriched supereggs, chicken feed can be supplemented with phytobiotics, or products derived from plants that contain a variety of secondary plant metabolites. Herbs like garlic/onion leaves, spirulina, basil leaves, turmeric powder, citrus pulp, flaxseed, red pepper, fenugreek seeds, etc. will be added to chicken feed as supplements.

These "super eggs" will have characteristics such as increased omega-3 fatty acids, decreased LDL cholesterol, immunomodulator, antioxidant, and anticarcinogenic qualities. For instance, a typical egg has a vitamin E level of 90–100 mg per gramme of yolk, whereas an egg with a herbal supplement has 220–240 mg per gramme of yolk, adding to its improved antioxidant capacity. All of these point to the possibility of promoting human health by popularising herbal-enriched foods, both in hens and possibly in humans.

As a Food, Egg Has Many Uses

Since 300 A.D., when an oral drench of up to 12 entire eggs was advised for the treatment of diarrhoea, hen eggs have been recognised as having potential as a functional diet. Furthermore, the yolk of hen eggs has been touted as a novel source of polyclonal antibodies that can act as passive defences against gastrointestinal infections. High concentrations of certain antibodies are seen in the egg yolk of hens that have been exposed to a bacterial infection. In multiple in vivo experiments, it has been demonstrated that oral delivery of certain antipathogen antibodies isolated from egg yolk from immunised hens can prevent infection. Certain egg-yolk

antibodies from immunised hens may bind prospective pathogens in the gut lumen and block their adhesion to the gut mucosa, thereby preventing the first stage of infection.

Conclusion

Consumers who prefer eggs with distinct nutritional qualities or characteristics from generic eggs have options thanks to designer eggs. Generic shell eggs are a cheap, high-quality, nutrient-dense source of protein that also contain a range of important vitamins and minerals and other useful ingredients. Eggs can serve purposes beyond the good nourishment they already give by feeding hens specialised diets. Designer eggs with novel functional characteristics are in high demand, but there is currently a shortage of expertise in their industrial manufacture. For the commercial manufacturing and marketing of these new generation eggs and egg products, more study is required. Further study in this exciting area is required to enhance the calibre of designer eggs, evaluate the long-term impacts of their intake, and finally persuade consumers of the advantages of eating these eggs.

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MOLECULAR BREEDING STRATEGIES FOR BIOTIC STRESS TOLERANCE IN PADDY

Kasanaboina Krishna[1], Marsukola Aparna[2], Awio Bruno[3] and G. Babith raj goud[4]

[1]Ph.D Research Scholar, ICRISAT, Department of Genetics and Plant Breeding, PJTSAU, College of Agriculture, Rajendranagar. Hyderabad, 500030, Telangana, India.

[2]Department of Soil Science and Agriculture Chemistry, PJTSAU, College of Agriculture, Polasa, Jagtial, 505529, Telangana, India.

[3]Ph.D Research Scholar, ICRISAT, Department of Genetics and Plant Breeding, PJTSAU, College of Agriculture, Rajendranagar. Hyderabad, 500030, Telangana, India.

[4]Department of Crop Physilogy, PJTSAU, College of Agriculture, Rajendranagar. Hyderabad, 500030, Telangana, India.

Email: kasanaboinakrishna@gmail.com

Introduction

With 60 percent of the world's food supply dependent on it, rice is a staple crop and the most significant security food crop. It is grown across many nations on an estimated 167 million ha of land, yielding 510.6 million tonnes of milled rice and 3.06 tonnes of paddy on average per hectare. (FAO 2019). Rice is one of the most frequently farmed food crops and ranks second in cereal cultivation globally. The main causes of the low rice yields in Asia and throughout the world (more than 70 Diseases) are among these. Unfortunately, a variety of viruses, insects, nematodes, and other pests attack the rice plant in various parts of the world, reducing the amount of rice that can be produced. Different infectious diseases are brought on by viruses, bacteria, nematodes, and fungi. Among the diseases, diseases like sheath blight, false smut, and brown spot are known to reduce yields up to 10-15% in certain seasons and years. Sporadic but potentially deadly illnesses like blast and bacterial blight are also known to do this. There have been reports of yield losses from bacterial leaf blight (BLB) in severe epidemics ranging from 20 to 40%. Sheath blight, on the other hand, has been found to result in yield losses of 20–30%, depending on the severity of the infection. As a result of attempts to understand the genetic basis of resistance and susceptibility as well as to breed new types that are resistant to these illnesses/stresses, it has become clear how much money is lost due to the various biotic diseases.

Molecular Approaches for Biotic Stress Resistance

Blast and bacterial leaf blight (BLB), in particular, are the main causes of yield instability in many rice-growing regions due to the breakdown of biotic stress resistance. In order to ensure sustainable rice production in the future, it is necessary to create techniques that offer long-lasting disease resistance against a wide range of diseases, providing protection for a long time over a large geographic area. To date, new resistant rice cultivars have been created using molecular breeding techniques using DNA markers, including QTL mapping, marker-aided selection, gene pyramiding, allele mining, genetic transformation, and novel methods of gene editing. These approaches are currently used as a high-throughput, low-cost substitute for

traditional methods, enabling the rapid introgression of disease resistance genes into susceptible types as well as the inclusion of several genes into individual lines for more resilient blast resistance.

Marker Assisted Backcrossing

Marker assisted backcrossing (MABC) is the process of using markers to select for target loci, minimize the length of the donor segment containing a target locus, and/ or accelerate the recovery of the recurrent parent genome during backcrossing (Hospital 2005). These three levels of selection have been referred to as foreground, recombinant, and background selection, respectively. Terms were described after Hospital and Charcosset (1997), who referred to foreground selection as the selection of a target locus and background selection as the selection of the recurrent parent genome using markers on noncarrier chromosomes and also on the carrier chromosome. MABC is superior to conventional backcrossing in precision and efficiency. Background selection can greatly accelerate the backcross breeding program as compared to conventional backcrossing. Furthermore, recombinant selection can minimize the size of the donor chromosome segment, thus reducing "linkage drag"—a "universal enemy" of the plant breeder. This approach has been widely used and, due to the prevalence of several rice "mega varieties", it is likely to continue being a successful approach (Singh 2016).

Marker-assisted backcross breeding (MABB) was used for incorporating bacterial leaf blight resistance genes *(xal3* and *Xa21)* into the genetic background of Pusa Basmati 1, which resulted into development of Improved Pusa Basmati 1 (Pusa1460) as one of the first basmati improved products of molecular breeding (Singh *et al.* 2011). Improved PR 106 and Improved Samba Mahsuri (RP Bio 226) was developed by MABB with three bacterial blight resistance genes, *xa5, xal3,* and *Xa21* (Sundaram *et al.* 2008).

Gene Pyramiding Approach

Resistant cultivars with one or two major resistant genes are unsustainable in the field and the only way to delay such a breakdown of BLB resistance is to pyramid many resistance genes using MAS (Rafique *et al.* 2010). Resistant germplasm carrying both major and minor R genes are the important genetic resource for rice breeders by which blast resistance will be improved in elite rice varieties. Pyramiding R genes, instead of quantitative resistance genes which are difficult to accumulate, has been the breeding strategy in case of bacterial blight and blast. However, with the evolution of new races/biotypes it has become necessary to develop broad-spectrum, race nonspecific resistance to combat the evolution of new virulence. To combat the problem of resistance breakdown, pyramiding of resistance genes into different cultivars is being carried out. Improved Lalat and Improved Tapaswini with *xa5, xal3,* and *Xa21* genes were developed at the National Rice Research Institute (Dokku et al. 2013). Lalat was further improved with resistance to blast (Pz2, *Pi9),* gall midge *(Gml, Gm4),* submergence *(Subl)* and salinity *(Saltol)* genes.

Allele and Data Mining

Rice landraces and wild relatives are a rich source of important genes that can be exploited to create varieties with enhanced stress tolerance and other agronomic features. Based on the information that is currently known about the genes, allele mining has been used to find novel alleles or allelic variants of a gene or candidate genes of interest from a variety of germplasm.

Multi-parent Populations

The use of landraces for breeding can be discovered, but is typically constrained by unfavourable linkages. Therefore, effective breeding strategies are required to convey valuable diversity in plant breeding. A breeding strategy to create highly recombined populations is called multi-parent advanced generation intercross (MAGIC). It entails numerous cycles of inter-mating among various paternal lines. Greater genotypic diversity, more recombination, and less linkage drag will all be present in MAGIC populations. These benefits have led to the MAGIC approach being used in many agricultural and plant species for genetic study and breeding (Bandillo et al. 2013).

Genome/Gene Editing Technologies

Genome editing is a relatively new technology that is gaining importance as a tool for crop improvement because of its advantages over routinely used methods of genetic engineering. Gene editing uses site directed mutagenesis (as opposed to random mutagenesis) to delete, insert, or replace a DNA sequence. Development of engineered site specific nucleases (SSNs) has paved the way for single nucleotide excision mechanism for crop improvement.

Genetic Engineering

Genetic engineering is the process of using recombinant DNA (rDNA) technology to alter the genetic makeup of an organism. Traditionally, humans have manipulated genomes indirectly by controlling breeding and selecting offspring with desired traits. Genetic modification of plants involves adding a specific stretch of DNA into the plant's genome, giving it new or different characteristics.

RNAi Approach for Insect Resistance

RNAi is an RNA-driven post-transcriptional homology-based gene-silencing mechanism. RNAi could be another alternative and effective tool to develop insect resistance in crop plants. Application of the RNAi tool for insect resistance in rice is in the developmental phase. Most of the reports on RNAi in rice are centered on BPH and YSB. RNAi has been used for functional genomics of glutathione S-transferase (GST) genes, which are involved in the degradation of toxins produced by host plants and insecticides.

Future Perspectives

The development of rice varieties with diversified resource of resistance with broadspectrum efficacy against numerous diseases. For successful development, there is a need to constantly improve yield, grain quality, multiple stress tolerance. With advancements in genome sequencing, the scope for utilization of genome sequences of both pest and host for

understanding mechanism of resistance as well as breakdown of resistance have increased. More focus should be given to vertical expansion of disease resistant varieties. Reducing selection pressure toward overcoming resistance traits by integrated disease management will help to extend the life of resistance genes in a particular cultivar/region. Strategic gene deployment integrated crop Management and Nutrient management can contribute to improvement in farmer livelihood and income through reduced fungicide use and reduced production costs in a sustainable manner.

Conclusion

The related species of rice and wild sources are important for identification of many resistance genes/QTLs, which are successfully introgressed or deployed or pyramided in numerous breeding lines through resistance breeding program and various molecular approaches. Breeding work utilizing both phenotypic and genotypic markers are more reliable and fast. DNA marker technology refers to the application of DNA-based markers in breeding programs to improve the selection efficiency (Sundaram *et al.* 2009). Breeders can use these markers to complement classical breeding techniques and can select segregating plants based on the DNA marker genotype rather than waiting to observe the phenotype.

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RAINFALL AND CROP PRODUCTION

C. Pradipa*, S.Prabhaharan, R.Jegathambal
ICAR-Krishi Vigyan Kendra
Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India
*Corresponding author: pradipachinnasamy@gmail.com

Introduction

Even though the technologies such as vertical farming, hydroponics and protected cultivation have emerged big, the food security of Indian population is mainly dependant on the distribution of weather parameters. Among the factors that govern the agricultural production and productivity, weather is the foremost factor. It can be said that the food security is tightly bonded to the changes in weather parameters. Each and every weather parameter has its own effect on the productivity of the crops. But, rainfall is considered to be the most affecting factor since it shows an eminence in crop planning to harvest as well as post-harvest planning. Rainfall is the variable that shows higher spatial as well as temporal variability. The rainfall is the prime source of soil moisture in case of rainfed agriculture which occupies the 60 per cent of Indian cultivable land area, in which 48 percent is under food crops and remaining under non food crops. All the operations in agricultural production, plant growth and health are primarily linked to soil moisture. The cheapest source of water for agricultural purpose is rain if received at timely intervals and appropriate quantities our national productivity would reach its potential. Rainfall has its role from crop planning till marketing. In simple words it could be said that rainfall determines the livelihood of the agrarian population in the semi-arid regions like India. Hence in countries like India, where rainfall decides the economic status of the nation, long term rainfall analysis and potential future planning is essential.

Rainfall and agriculture

Rainfall is the sole parameter that expresses vast variability –spatially as well as temporally. It is an erratic and uncertain event but have a greater importance in agricultural production. The distribution and intensity of rainfall is of greater importance in addition to that of amount of rainfall.

Temporal variability of rain fall over a region is crucial in selection of crop, variety, sowing window, introduction of new crop or variety, cultural practices, water shed planning and so on. Not only the rainfed region but also cultivable area under tank, canal and even well irrigation is rainfall dependent. Deficit as well as excess rainfall has its impact on agricultural production. In many regions flood is a major disaster that wash away the crop. For example this is experience in Cauvery delta areas of Tamil Nadu every year.

Rainfall pattern

Even with advancement in agricultural production technology, the crop planning mainly depends on the rainfall pattern and the season of the locality, except controlled environment farming practices. The success or failure of the crop is mainly determined by the rainfall

characteristics. A detailed knowledge on the onset of cropping season is needed and this could be arrived based on the rainfall pattern. Hence, rainfall pattern at a place is an important prerequisite for agricultural planning and management.

Dealing with study on the rainfall pattern of a region includes assessing the intra seasonal, inter-seasonal and annual rainfall variabilities. Beyond quantity of rainfall over a region its distribution during the cropping period is most important. Not only for better crop planning but also for determining irrigation, facilitating drainage, planning for water and soil conservation structure understanding the rainfall characteristics is important.

Wet and dry spell analysis

In order to stabilise the productivity and use the available sources of rainfall over a rainfed region beyond proper rainfall forecast, it is essential to programme the agricultural practices based on the scientific analysis of the past data. The rainfall in the semi-arid tropics is a seasonal phenomenon that too with higher variability (intra seasonal, interseasonal and interannual). The shorter scale variabilities are characterized by wet and dry spells of continuous rains or no rains. Mainly in the dryland regions assessment of dry spells is very much essential to attain the maximum potential of the region. This demands for the analyses of the wet and dry spell over an area to prepare contingency crop planning based on the probability of their occurrence.

In case of rainfed cultivation, irrigation planning and in many other decision making process, the start and length of dry spell and wet spell plays a vital role. The identification the chance of occurrence of dry and wet spells is a basic analysis for successful crop planning, formulation of water conservation techniques, identification of suitable crops and varieties, construction of water harvesting structures.

Rainfall trend analysis

In the present scenario of climate change knowing the changes in rainfall trends is inevitable. Rainfall received over the locality decides the amount of water availability over the region. In case of agriculture, any small changes in the natural phenomenon would have large impact on the production and health of the crops. Hence, it is indispensable to study the change in amount of monthly, seasonal and annual rainfall over a region to frame and suggest the possible adaptation strategies.

Rainy day analysis

A day with more than 2.5mm of rainfall is termed as rainy day. The rainy days are of chief importance because it is the minimum amount of rain fall that can be useful for the crop. The number of rainy days distributed over a month, season and annual period has its significance in planning for a crop and cultural practices. Rainy days are of utmost importance for farmers, since it is the minimum amount of rainfall that can reach the swallow root zone of the crop to meet the water requirement of the crop. The distribution of rainy days over the month, cropping season and year is necessary to planning the crop production activities.

Length of growing period

In the region where majority of area is under rainfed condition it is necessary to analyse the past data to plan the future in terms of rainfall availability to be in co-ordination with that of water requirement. This can be done by identifying the length of growing period. Length of growing period is the duration between the onset and cessation of agriculturally usable rainfall. Each crop has its own characteristics in terms of water requirement. Length of growing period depends on the rainfall distribution, stored soil moisture, temperature and inturn evapotranspiration. The short term rainfall analysis viz., pentads or over weeks is necessary for crop planning. The onset and cessation of a growing season based on rainfall distribution helps in selecting the crop and variety based on the duration of the growing period.

Conclusion

Among the various factors affecting the agricultural production, weather is the most important one. Every phase of growth and development in plant is affected by weather. Among the weather parameters, rainfall and its distribution fluctuates greatly than other parameters. Any variability in the rainfall during the crop season, such as delay in onset of monsoon, excessive rains and prolonged dry spells would affect the crop growth and finally the quality and quantity of the produce. Adoption of real time contingencies in crop management based on weather forecasts can minimize crop losses. Hence, planning of agricultural activities based on the rainfall pattern that prevail over a region is necessary for successful farming.

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Soll Science	Genetics & Plant Breeding	Poultry
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