International Journal of Pure & Applied Bioscience

Soil Status in Relation to Blast Disease in Bundi District of Rajasthan, INDIA

Rohini Maheshwari, Indu Rani Sharma*
Department of Botany, Govt. P.G. Collage, Kota (Raj.)
University of Kota, (Rajasthan), INDIA.
*Corresponding Author Email: indurani106@gmail.com

_____

ABSTRACT

This review highlights the study made for identification of the soil characteristics influencing on the blast disease in the rice fields of Bundi district, Rajasthan (India). Physiochemical analysis like pH, EC, Carbon, nitrogen, phosphorous and potassium contents were tested. The pH of soil ranges from 7.14 to 8.28. EC ranges between 220 s to 430 s. O C ranges from 0.37 to 0.85%. Nitrogen content varied from .035% to .087%. Phosphorus ranges from .28kg/ha to .65kg/ha. Potassium ranges between 350kg/ha to 396kg/ha.
Alkaline pH, high concentration of salt, organic carbon, nitrogen and low concentration of potassium and phosphorous, infects the plant health leads to the blast disease in bundi district, mainly observed in keshavrai patan.

Keywords: - *physiochemical analysis, Electrical conductivity, organic carbon content.*
_____

INTRODUCTION

Soil may be defined as a thin layer of earth's crust which serves as a natural medium for the morphological, physical, chemical and biological properties. Plants obtain all the nutrients, and most of their water, from the soil. Soil quality is one of the important factors controlling yields of the crops. Soil characterization in relation to evaluation of health status of the plants of an area or region is an important aspect in context of sustainable agriculture production**.** India is the largest rice-growing country of the world and the crop is cultivated under varied conditions of soil and climate provided the requirement of water is adequately met. India has varied soils with varied climates. There are many varieties of rice cultivated in the country according to their adaptability to soil conditions, which may broadly be divided into two groups, namely (i) wet-land paddy (ii) dry-land paddy.

Nutrition, although frequently unrecognized, has always been a primary component of disease control. In this respect, all nutrients affect plant disease. However, some nutrient elements have a direct and greater impact on plant diseases than others. Nutrients and other mineral elements can have a significant impact on all the aspects of the disease cycle. Plant nutrients may affect disease susceptibility through plant metabolic changes, thereby creating a more favorable environment for disease. Successful colonization of plants by pathogens requires efficient utilization of nutrient resources available in host tissues, by affecting the growth pattern, the anatomy and morphology and particularly the chemical composition[1,2,3,4]. Because of imbalanced and inadequate fertilizer use coupled with low efficiency of other inputs and introduction of high yielding varieties (HYV) in Indian agriculture, the farmers has compelled to use high doses of NPK fertilizers which is responsible for occurrence of blast disease of rice [5]. The soils of Rajasthan vary from desert sand to heavy clay with all intermediate stages like sandy loam, loam and clay

loam. Loam and clay loam are more prevalent on the eastern, northeastern and southeastern areas of the state. These types of soils have more potential from the agricultural point of view. The present study area lies in the southeastern area of the Rajasthan.

A study of soil profile supplemented by physical and chemical properties of soils give full picture of soil fertility and productivity. Knowledge of soil in regard to its potential use, distribution and optimum use of land and with a view to understanding the effect of soil parameters on the growth behaviour of *Oryza sativa*, a study was taken up in rice fields of Bundi district, Rajasthan, in India. The objective of this study was to improve the knowledge of soils used for rice productions in Bundi and identifying the soil characteristics influencing on the blast disease in the rice fields.

MATERIAL AND METHODS

In the present investigation an intensive survey of the various localities viz. Ajjanda, Arnetha, Radi, Kapren, keshavraipatan, Gandoli (Tehsil-Keshavraipatan), Laban, Deikhera (Tehsil Indragarh), Gardara, Hattipura, Bardha, Dolara, Matunda, Namana, Talera (Tehsil Bundi), Satoor (Tehsil Hindoli) and Karwar (Tehsil Nainwan) covering the major rice growing areas of the Tehsils of Bundi district, was conducted during Kharif season of 2009-2010 (from July to November) for the occurrence and incidence of blast disease in terms of PDI and the status of soil and its influence on rice blast disease caused by *Pyricularia oryzae,* in rice growing areas of Bundi district of Rajasthan. The occurrence and incidence of blast disease was calculated on rice plant samples by using the disease rating scale of 0-5 developed for foliar diseases[6].

O =no symptoms.

      1 = 1 – 5 % (Few) spots on <50% of leaves

      2 = 5 – 20% spots on <50% of leaves

      3 = 5 – 20% spots on >50% of leaves

      4 = 20 – 50% spots on <50% leaves

      5 = >50% spots on >50% leaves

The formula used for calculation of Percent disease incidence is as follows:

$$\text{Percent disease Incidence (PDI)} = \frac{\text{sum of individual disease rating}}{\text{Total number of leaves observed}} \times \frac{100}{\text{Maximum Rating}}$$

For soil analysis, soil samples were collected from rice fields with the help of soil corer to a depth of 0-15cm. Four to six pits were dug for each sample. From each pit sample was collected at a depth 0-31cm and gathered together to form a composite sample. Composite samples were dried, grounded with wooden motto and passed through 2mm sieve. After sieving all the samples were packed in polythene bags for laboratory investigation. Standard analytical methods were used for the analysis of soil samples. The soil samples were analyzed for Soil PH [7], Soil Conductivity [8], Organic Carbon [9], Total Nitrogen Kjeldahl method given [10], Phosphorus [11] and Potassium [12] contents in soil samples. Physicochemical analysis of soil was done in laboratory by following standard methods.

RESULTS AND DISCUSSION

In the present investigation soil samples were collected and analyzed from 17 different localities viz. Ajjanda, Arnetha, Radi, Kapren, keshavraipatan, Gandoli (Tehsil-Keshavraipatan), Laban, Deikhera (Tehsil -Indragarh), Gardara, Hattipura, Bardha, Dolara, Matunda, Namana, Talera (Tehsil- Bundi),

Satoor (Tehsil- Hindoli) and Karwar (Tehsil - Nainwan) covering the major rice growing areas of the Tehsils of Bundi district, during Kharif season of 2009-2010 (from July to November).

Table No. 1 – Physicochemical analysis of soil samples collected from rice fields of 17 different sites of Bundi district, Rajasthan.

S.N.	Thehsil	Location	pH	Electical conductivity (EC) in µS/cm	Organic Carbon (OC) in%	Total Nitrogen in %	Available phosphorus (P)in mg/kg	Available Pottasium(K) in kg/ha	PDI IN %
1		Ajjanda	7.7	430	.73	.068	.57	372	16.00
2		Arnetha	8.0	350	.61	.067	.32	386	14.23
3	Keshavrai Patan	Radi	8.0	260	.63	.063	.38	396	35.00
4		Kapren	8.1	330	.85	.076	.45	384	22.67
5		Keshavrai Patan	7.14	240	.69	.087	.28	356	50.67
6		Gandoli	8.3	380	.71	.083	.40	350	36.00
7	Indargarh	Laban	8.5	350	.64	.065	.45	376	17.33
8		Deikhera	8.7	370	.49	.035	.53	389	13.67
9		Gardara	7.8	400	.42	.073	.65	385	14.82
10		Hattipura	8.2	380	.64	.066	.40	387	29.20
11		Bardha	8.5	282	.63	.073	.38	392	43.90
12	Bundi	Dolara	8.3	220	.56	.082	.34	372	18.82
13		Matunda	8.2	260	.70	.048	.44	358	28.20
14		Namana	7.9	380	.46	.053	.40	380	25.22
15		Talera	7.6	360	.57	.061	.34	372	40.33
16	Hindoli	Satoor	8.1	350	.47	.048	.34	383	15.92
17	Nainwan	Karwar	8.o	340	.37	.063	.50	379	17.78

Major soil types found in Bundi district were Deep brown loamy (23.57%), Deep brown clayey (15-25%), Medium brown loamy (15.11%), Red gravelly loam hilly soil (16.01%), Deep black clayey (8.61%) and Shallow yellowish brown gravelly loam (14.24%), Out of the above six varieties of soils, four types viz. Deep brown loamy, Deep brown clayey, Medium brown loamy and Deep black clayey are the most suitable for rice cultivation in the area. (KVK, Bundi)

The pH of the soil samples investigated from 17 surveyed localities varied from 7.14 to 8.7. The maximum pH of the soil sample was recorded from Garadara locality and minimum pH was recorded from Keshavrai Patan locality.

The total soluble salt content of the soil samples was expressed as electrical conductivity (EC). The values of EC varied from 220   s/cm to 460   s/cm in the area. The mean EC of the samples was 334   s/cm.

The organic carbon content (%) of soil samples varied from .37 %to .85%, with the mean value of 0.6%. The distribution of soil samples with respect to organic carbon, content indicated that 17% of soil sample fall in organic carbon range of 0.3 to 0.5%, 53% of soil samples having 0.5 to 0.7% soil samples had more than 0.7% content of organic carbon.

Total nitrogen content (%) of soil samples collected from rice fields varied from 0.35% to .087%. Distribution of soil samples with respect to total nitrogen content showed that only 5% to soil sample fall in .005 to .01% to total nitrogen range, 11% soil sample nitrogen in range of 0.01 – 0.05%, whereas most of the soil sample that is 76% had nitrogen in the range of 0.05 – 0.1%. Overall soil sample of rice fields were rich in total nitrogen content.

Available phosphorus (P) (kg/ha) content of soil samples of rice fields of Bundi district, ranged from 0.28kg/ha to 0.65kg/ha. About 77% of soil sample fall in the range of .25 to .5 and 23% of soil samples fall in the range of .5 to .75.

Available potassium (k) content of soil samples varied from 350kg/ha to 396kg/ha. The maximum value was recorded from Radi locality and minimum value was recorded from Gandoli locality.

Physicochemical analyses of soil samples from rice fields of 17 localities in Bundi district were examined. Physiochemical properties like pH, EC, total organic carbon, total nitrogen, available phosphorus and available potassium are indictors of soil quality in understanding the nutrient status of soil and also its correlation with prevailing blast disease in the area and therefore were examined to study soil fertility status.

pH is an important parameter to determine acidic or basic nature of soil. In the present study soil pH was found to be alkaline in the range of 7.14 to 8.28 which is in confirmation with earlier findings. The pH of soil is important in the occurrence and severity of plant diseases. Many researchers also showed that among different physicochemical properties pH is important in determining growth and establishment of plant disease in field [13,14].

Electrical conductivity is an important factor in determining the salinity of soil. It represents the availability of salts in the soil. In the present investigation the value of EC ranged between 220 s to 430 s in the studied area. Increase in electrical conductivity of soil, increases the availability of soluble salts to the plants and thus effect on soil fertility status of the soil which in turn may affect plant health [15].

Organic carbon content of the investigated soil was high enough. The value of O C ranged from 0.37 to 0.85%. The quantification of organic carbon content helped in determining the soil quality and productivity, as observed by Krishnan *et al* (2009).

Nitrogen is an important nutrient required by rice plants during tillering stage to ensure a sufficient number of panicles. From the internode elongation, through the beginning of head formation; nitrogen must be available in sufficient amount to promote the maximum number of grain.

Soil samples from rice field showed high range of organic carbon content which is an indicator of available nitrogen status of soil thus as shown in the table 1 soil is also rich in available nitrogen content. The total nitrogen content varied from .035% to .087%. The amount of nitrogen content in Keshavrai Patan locality was highest that is .087% and lowest in Dei khera locality i.e. .035%.

One of the most commonly assumed relationship of N to plant disease is that high N rates lead to more diseases. Excess of nitrogen in field causes excess of vegetative growth of plant and delays maturity. This predisposes the rice plant host to the blast disease. This may be the reason of occurrence of highest PDI of blast disease in the Keshavrai Patan locality, as the highest nitrogen content in soil was calculated and investigated from this area. The result was in corroborate with Osuna [16]. Schneider also observed the effect of high nitrogen content on plant disease while studying *Fusarium* yellow on celery He found that high nitrogen application is responsible for prevalence of the above disease. Long *et al* (2000) suggested that increased levels of nitrogen are critical in the management of rice blast. Several studies suggested that excessive nitrogen increases N metabolism in rice plant leading to enhanced tissue susceptibility to blast disease (Matsuyama and Diamond 1973, Ou 1985, Kruschner *et al* 1992 and Katsantonis *et al*

2008).And this may be the possibility of the prevalence of blast disease, more in the area having more soil N values, in present study.

Available phosphorus content in soil samples were ranged from .28kg/ha to .65kg/ha. Phosphorus availability is optimum when Ph is below 6.5 that are between 6.0 to 6.5 (Haifa, 2009). In present study the soil found to be alkaline.

In rice plants, phosphorus promotes tillering, root development, early flowering and ripening of plant. In present investigation value of phosphorus in Keshavrai Patan locality was lowest that is 0.28kg/ha and this may be one of the cause of prevalence of blast disease more in that locality. These findings could validate theclaim made by Shaheen *et al* (2007) that phosphorus increased plant resistance to diseases. The same findings were made by Nawaz *et al* (2012), in take-all disease of barley caused by *Gacumannomyces graminis* and Potato scab caused by *Streptomyces scabies*. Phosphorus seems to increase resistance either by improving the balance of nutrients in the plant of by accelerating the maturity of crop and allowing it to escape infection by pathogens that prefer younger tissues.

Potassium is essential for many physiological processes, such as photosynthesis, translocation of photosynthetic products into sink organs, maintenance of turgescence, activation of enzymes, and reducing excess uptake of ions such as Na and Fe in saline and flooded soils (Cakmak, 2002. IPI golden jubilee congress, 1952-2002, Basel, Switzerland).Potassium level is also important in disease resistance of physiological disorders. (Haifa, 2009).In present investigation the amount of potassium in soil samples found to range between 350kg/ha to 396kg/ha. In the locality Keshavrai Patan where percent disease incidence of blast disease was highest, the soil potassium value was 356 (low), as compared to the other localities. The above results matched the results observed by various workers (Siebold 1980, Glynne 1960). Mariani (1952) found that application of KCl to soil reduced blast attack and panicle sterility and markedly increased the weight of panicles. These results were in harmony with those obtained by other researches (Bernier *et al* 1982, Amtman *et al* 1999).

Potassium deficient plants have low total carbohydrate content but have a higher concentration of soluble salts (Mengel and Kirky 2001) which may provide a suitable substrate for the growth of blast pathogen.

 Rice plant receiving high amount of potassium accumulated more phenol and ortho-hydroxy phenols, which in turn render the plant system resistant to pests (Vaithilingam *et al* 1985).Increase in lignifications and sclerenchymatous layer with enhanced k nutrition in rice could also acts as a mechanical barrier to pest invasion in potassium treated plant. (Sekhon, 1999) .Thus low potassium level in soil of Keshavrai Patan locality may be one of the possible causes of prevalence of blast disease in that area more than any other area. In contrast the value of potassium Dei Khera was 389 that is higher, supporting the result that amount of potassium in soil may be somehow responsible for low P D I and relative less occurrence and prevalence of blast disease in the area.

Thus a study on soil nutrition balance is essential to ascertain the future sustainability of soil fertility. It would also help the farmers to guage the appropriate management of plant disease specially blast in the area. It is also suggested that nutrient balance is particularly important in the context of plant health. The dual benefits of fertilizer applications with regards to improvement in production as well as improved disease resistance need to be highlighted to increase both soil quality and disease management.

Figure-1:

Soils of Bundi district,Rajasthan
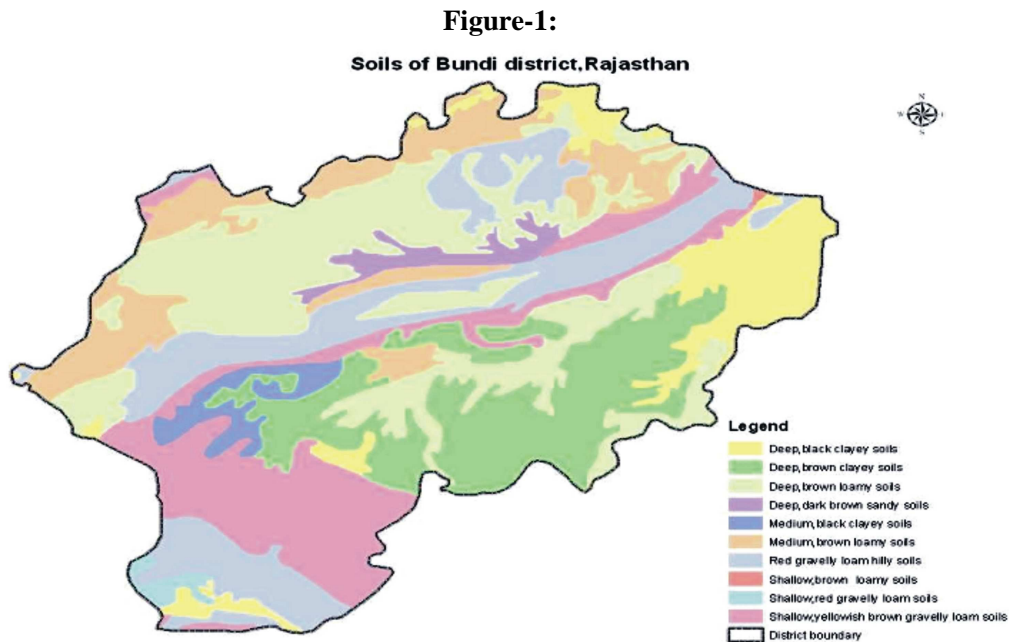
CONCLUSION

In the present investigation soil samples were physiochemical analyzed for incidence of blast disease in rice field. Maximum pH was recorded from Garadara locality and minimum pH was recorded from Keshavrai Patan locality. Electrical conductivity (EC) of the samples was 334 s/cm. soil samples had more than 0.7% content of organic carbon. Total nitrogen content (%) of soil samples collected from rice fields varied from 0.35% to .087%. Overall soil sample of rice fields were rich in total nitrogen content. About 77% of soil sample fall in the range of .25 to .5 phosphorous and 23% of soil samples fall in the range of .5 to .75 phosphorous. The maximum value of potassium was recorded from Radi locality and minimum value was recorded from Gandoli locality.

Acknowledgement

REFERENCES

1. Krauss A. Einflusa Der Ernahrung Der P flanjen Mit Mineral soften auf Den Befall Mit Parasiteran Krankheitan und Schadlingen Z.Ppflanzenernahr Boden kd **124:**129-147 (1969)
2. Graham RD. Effects of nutrient stress on susceptibility of plants to diseases with particular reference to trace element. *Adv. Bot. Res.* **10 :** 221-276 (1983)
3. Perrenoud S. Potassium and plant health .IPI Reaserch topic number 3, 2 [nd] rev. eds. Basel .Switzerland.(1990)
4. Marschner H. Mineral nutrition of higher plants. 2 [nd] eds. *Academic press.* pp 436 -460 (1995)
5. Singh R S. Plant diseases. 7 [th] Edi. Oxford and IBH publishing company Pvt. Ltd. (1998)
6. Anonymous, Standard evaluation system for rice. 4 [th] edi. IRRI, Phillipines (1996)

7. Mc Lean E O. Soil pH and lime requirement In A L Page *et al.* Methods of soil analysis. Part 2 2 nd edi. Argon Monogr 9 ASA and SSSA. Madison Wis. p199-224 (1982)

8. Richards LA. Diagnosis and improvement of saline and alkali soils. U S salinity laboratory USDA. Agric handbook number 60 pp 160 (1969)

9. Walkely A. and Black I A. An examination of the degtiareff method for determining soil organic matter and a proposed modification of the cromic acid titration method. *Soil Science.* **37:** 29-38 (1934)

10. Piper CS. Soil and Plant Analysis, Hans Publisherd Bombay (1960.)

11. Olesen SR. Cole Watanabe FS and Dean LA Estimation of available phosphorus in soil by extraction with sodium carbonate. Circ. US Dept. Agric. 939 (1954)

12. Toth SJ and Prince AL. Estimation of cation exchange capacity and exchangeable Ca, K and Na contents of soil by flamephotometric techniques . *Soil sci.* **67:** 439 -445 (1949)

13. Mehrotra R S and Agarwal Ashok, Plant pathology 2 nd edi. Tata Mc Graw Hill publishing com. Ltd (2003)

14. Agriose G N. Plant pathology 4 th edi. Academic Press (2004)

15. Pitchel and Hayes, Influence of fly ash on soil microbial activity and population . Jour. of Environ. Quality, **19 (3):** 593-597 (1990)

16. Osunna Canizalze FJ, Dtta SK and De Bonman JM. Nitrogen form and silicon nutrient effects on resistance to blast disease of rice. Plant and soil. **135 (2):** 223-231 (1991)

17. Amtmann A , Jelitto TC and Sanders D. Potassium selective inward reactifying channels and aoplastic pH inbarley roots. Plant Physio.**120:** 331-338 (1999)

18. Bernier CC and Coner RL. Breeding for resistance to faba bean rust. pages 251-257 (1982)

19. Cakmak. 2002. IPI Golden jublee congress; 1952-2002, Basel Switzerland Glyne MD. 1960. Effect of potash on powdery mildew. Potash review subject 23, 22nd suite.

20. Krishnan G, Srivastav SK, Kumar S, Saha SK and Dadhwal VK. Quantifying the underestimation of soil organic carbon by Walkley and Black technique examples from Himalaya and central Indian soils, Indian Institute of Remote sensing (2009.)

21. Kurschner E ,Bonmann JM, Garrity DP, Tamisin MM, Pabale D and Estrada BA. Effect of nitrogen timing and split application on blast disease in upland rice. Plant diseases, **76:** 384-389 (1992)

22. Long DH, Lee FN and Te Beest DO.Effect of nitrogen fertilizer on disease progress of rice blast on susceptible and resistance cultivars. Plant disease, **84:** 403-409 (2000)

23. Mariani C. Influence of potash fertilization on resistance against *Pyricularia oryzae* of rice plant.Potash review subject 23 fifth suite (1952)

24. Matsuyama N and Diamond AE . Effect of nitrogen fertilizer on biochemical process that could affect lesion size of rice blast. Phytopath. **63:** 1202-1203 (1973)

25. Mengal K and Kirkby EA. Principals of plant nutrition Dordrecht, Kluwer academic publisher. 849pp (2001)

26. Nawaj Haq, Mohammad Zubair and Hafiz Derawadan. Interactive effects of nitrogen, phosphorus and zinc on growth and yield of tomato (*Solanum lycopersicon*). *African journal of Agr. Reas.* **7: (26)** pp 3769-3792 (2012)

27. Nutritional recommendation for rice, Haifa-piconeering the future p 1-84 (2008)

28. Ou SH. Rice Diseases.CAB International Mycological, Institute Kew, Survey, UK (1985)