Determination of Available Nitrogen (N), Phosphorus (P) and Potassium (K) in Soil Samples of Bangarwadi, Satara For Sunflower Crop

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Abstract

A study of soil samples was done to determine the concentration of the available Phosphorus (P), Nitrogen (N) and Potassium (K). Samples were collected from different places at different depths of Bangarwadi Village. Nitrogen were detected by using Kjeldahl apparatus. Phosphate was determined as available phosphorus by Spectrophotometric method, which was measured at 660nm. The available potassium was determined by flame photometry. All soil samples were analyzed and obtained results were reported. Having a rich supply of N, P, and K nutrients in the soil promotes vigorous plant growth, which in turn results in superior quality produce and boosts annual production yields.

Key words: Nitrogen (N), Phosphorus (P), and Potassium (K)

I. Introduction:

The objective of nutrient management is to optimize plant productivity while mitigating environmental impacts. Nutrient management plans systematically document available nutrient sources, production practices, and other management strategies that affect nutrient availability, crop productivity, and environmental stewardship. For over four decades, soil testing has been recommended as a method for predicting the type and quantity of fertilizers required. Yet many farmers still do not use this relatively simple tool to increase fertilizers profitability. Producers continue to apply fertilizers inappropriately, either in areas where they are unnecessary, at suboptimal rates, or at excessive rates, in an attempt to optimize yields. Some employ insufficient rates or ineffective application methods. Although soil test recommendations for nutrient requirements and optimal rates for maximum profit are not infallible, they are preferable to the absence of a soil testing program. The increase in paddy yield due to fertilizer application based on soil test recommendations ranged from 7.22% to 69% compared to traditional farmer practices [1]. Fertilizer adjustment equations and post-harvest soil test value prediction equations for the *kharif* and *rabbi* seasons were developed using data on grain yield, total nutrient uptake, initial soil test values, and fertilizer doses. These equations provided fertilizer doses for achieving desired yield targets in rice crops. A soil test-based nutrient management approach can serve as a crucial entry point activity and a mechanism for diagnosing and managing soil fertility in practical agriculture [2]. Soil test-based nutrient application also allows judicious and efficient use of nutrient inputs at the local

and regional levels [3,4] reported existence of operational range of soil test values after fertility gradient experiment with preliminary crop pearl millet for development of soil test based fertilizer recommendation to obtain economic yield of wheat crop. Nitrogen (N), phosphorus (P) and potassium (K) fertilizers are well-known mineral elements necessary for plant growth and development [5], and the application of fertilizers containing these elements can significantly improve the yield and quality of sunflower crop [6]. However, in actual production, the proportion of N, P and K is often unbalanced due to the lack of scientific ratio, which affects the absorption and utilization of nutrients by plants, reduces the yield and quality, and increases the risk of nutrient loss and environmental pollution [7]. A balanced ratio of nitrogen (N), phosphorus (P), and potassium (K) can significantly enhance plant growth while reducing the overall quantity of fertilizers required [8]. In the context of proportion-based fertilization, determining the optimal ratio of N, P, and K, as well as the appropriate application rate, necessitates consideration of the species-specific fertilizer requirements, the nutrient supply characteristics of the soil, the efficacy of the fertilizers, and the rules governing nutrient interactions [9]. Furthermore, no universal fertilization model has been identified that is applicable to all plant species, fertilizers, and regions [10]. In Bangarwadi village, the considerable variability in climate, soil fertility and texture, and crop varieties has substantially influenced the application rates and proportions of N, P, and K fertilizers, leading to instances of improper fertilizer use. The objective of this study is to elucidate the impact of soil test-based fertilization on soil nutrient status and various growth parameters of sunflowers, thereby enabling farmers in the region to benefit from the judicious use of fertilizers following soil testing.

II. Material & Methods:

Determination of available Nitrogen from Soil

Take 5 gram in a long testing tube & 25 ml 0.33% $KMnO_4$ in it& put it in to kjeldals equipment. Take 25 ml of 2% boric acid in 250ml conical flask & add 3-4 drops of mixed indicator in it. Add 25 ml of 2.5% NaOH through reagent which placed outside of machine & directly connected to test tube in the equipment. The conical flask containing boric acid and mixed indicator which kept inside the machine where gas passed by pipe &still remove when colour change against 0.1N NH_4 Cl solution.

Determination of available Phosphorus from Soil

Take 2gm sample in 250ml conical flask. Add 15ml 0.5M $NaHCO_3$ into it & shake well & shake well. Filter it through ordinary filter paper. Take 5ml filtrate into a 50 ml volumetric flask. Add 4-5drpos of P-nitro phenol into it then yellow color obtained. Add 2.5 M H_2SO_4 that time Co_3 evolved. Till the solution become colorless. Add 10ml Ammonium molybidate into it. Add freshly prepared 1ml Stannous Chloride ($SnCl_2$).After the complete addition measure the absorbance at 660nm at double beam spectrophotometer.

Determination of available Potassium from Soil

Take 5 g soil sample in a 100 ml conical flask.Add 25 ml of 1 N ammonium acetate to it.Shake this solution on a shaker at 180 rpm for 1 hour.Then filter this solution using Whatman No. 42.Use this filtrate to determine K (potassium) using a flame photometer.

Table No. 1: N, P, K analysis of soil samples

Soil samples	N	P	K
1	125.44	4.73	103.04
2	137.98	10.25	76.16
3	62.72	11.43	943.04
4	37.63	0.79	449.12
5	87.81	1.18	188.16
6	25.09	3.55	226.24
7	112.90	3.94	77.28
8	137.98	3.94	203.84
9	50.18	3.55	136.64
10	125.44	4.34	315.84

III. Results & Discussion:

The strategic combination of nitrogen (N), phosphorus (P), and potassium (K) can significantly enhance both the yield and fruit quality of sunflower crops. The results of this study are detailed in Table No.1, which presents data on a per hectare basis. Research has demonstrated that these nutrients, along with their interactions, exert a substantial influence on citrus yield, quality, and the residual availability of soil nutrients. The integrated application of N, P, and K has been shown to increase yield and improve the quality of sunflower grains. A judicious application of N, P, and K fertilizers is essential for maintaining the nutritional balance of sunflower crops and enhancing their yield. The findings of this experiment suggest that varying levels of N, P, and K, when applied in combination, have a pronounced effect on the yield and quality of sunflower crops. A thorough evaluation of various indicators reveals that potassium (K) fertilizer has a more substantial influence on the yield and quality of sunflower crops than nitrogen (N) and phosphorus (P) fertilizers. This pronounced effect is likely due to the potassium deficiency in the soil of the region under study, where fertilizer plays a pivotal role in determining fruit quality. Our research

demonstrates that K fertilizer markedly increases soluble sugar levels while reducing titratable acidity in sunflower crop fruit. Potassium fertilization is crucial for enhancing growth, yield, and seed quality in sunflowers, particularly under drought conditions. It supports root health, facilitates flower and fruit development, and bolsters the plant's resilience to stress, such as drought. Proper application of potassium can also boost the concentrations of oleic acid, linoleic acid, and proteins in sunflower seeds, and is vital for the formation of new stems and leaves. Chlorophyll, a critical component for photosynthesis, is significantly influenced by nitrogen levels. An excess of nitrogen can result in overly vigorous vegetative growth, which may delay plant maturity and reduce seed oil content. The timing of nitrogen application is crucial; applying it just before the initiation of florets can affect the total seed count, while applications from floret growth to anthesis can impact the weight of individual seeds. Research indicates that nitrogen fertilizer application markedly affects the fruit quality of sunflower crops. This effect may be associated with phosphorus (P), which contributes to the accumulation of anthocyanins in plants by participating in the expression of genes involved in anthocyanin synthesis. Phosphorus is essential for plant metabolism, and its judicious application can enhance crop yield by promoting robust root growth and supporting the development of flowers, fruits, and root systems. It plays a vital role in photosynthesis, energy storage, and transfer, and adequate phosphorus levels improve plant water use efficiency and the effectiveness of other nutrients. Phosphorus is crucial for seed formation and aids plants in coping with cold temperatures and moisture stress. For optimal sunflower growth, nitrogen (N) facilitates leaf and stem development, phosphorus (P) supports root and seed development, and potassium (K) enhances overall plant vigor, drought resistance, and seed quality. Therefore, to enhance the yield and quality of sunflower crops, it is imperative to determine and apply the appropriate ratio of N, P, and K fertilizers to achieve increased yield and efficient fertilizer use.

V. Conclusion:

Samples were collected from Bangarwadi Village and carryout analysis, obtained results were reported in table. In conclusion, rational and optimized application of N, P and K fertilizer can achieve good-quality and high-yield of sunflower crop. In production practice, the optimal fertilization scheme should be determined according to the soil fertility status, referring to the optimal nitrogen, phosphorus and potassium fertilization amount in this study, and based on the principle of increasing N and K, and stabilizing P.

VI. References:

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