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Effect of different nutrient levels on growth and yield of some medicinal plants

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Abstract
Plants have been one of the important sources of medicines ever since dawn of civilization. India is known as botanical garden of the world, with its vast bio-diversity and potential for commercial exploitation. Plant nutrition is the major factor which influences the growth and development of plant. Inadequate supply of plant nutrients is detrimental to plant growth and has a negative effect on the yield. Thus, the maximum yield can be obtained with optimum nutrient levels. The effect of nutrient elements at different level on the properties of medicinal plants was reviewed. Hence, the investigations carried out showed that effect of different levels of essential nutrients mainly macronutrients in the way of increasing the number of traits such as plant height, leaf area, yield seed, and oil content.

Keywords: nitrogen, phosphorus, potassium, leaves number, growth, yield

Introduction
Medicinal plants form a numerically large group of economically important plants which provide basic raw materials for medicines, perfumes, flavors and cosmetics. These plants and their products not only serve as valuable source of income for small holders and entrepreneurs but also help the country to earn valuable foreign exchange by way of export. It is estimated that, about 3000 plants were recognized in India for their medicinal value and of them, 200 species are in wide use for their curative properties. According to World Health Organization, the global market for plant based medicines will hit 5 trillion US dollar by 2030 (Anon., 2013) [5]. Medicinal plants are those plants which are rich in secondary metabolites and are potential source of drugs. This secondary metabolite includes alkaloids, glycosides, coumarins, flavonoids, steroids etc. Drugs are derived from trees shrubs and herbs and even from primitive kinds of plants which are not even these. They are made from fruits (Senna, S.viarum, Datura etc.) flowers (Buteamoros-perma, Bauhinia verigata) leaves (Senna, Datura, Periwinkle, Tylophora etc.) stems (Liquorice, Ginger, Dioscorea, Costus, Garlic) roots (Rauvolfia, Periwinkle, Ginseng etc.), seeds (Isabgol, Abrus, Nuxvomica) and even bark (cinchona).

According to Government of India, Ministry of Agriculture, Department of Agriculture and Co-operation, New Delhi, Horticulture Statistics at a Glance, 2015 India consists of around an area of 499400 ha with a 925810 metric tons of production having productivity of 1.90 MT/ha and Karnataka consists of around an area of 3750 ha with a production of 7560 metric tons having 2.01 MT/ha productivity.

Plant nutrition is the major factor which influences the growth and development of plant. Inadequate supply of plant nutrients is detrimental to plant growth and has a negative effect on the yield. Thus, the maximum yield can be obtained with optimum nutrient levels. The seed treatment with bio-fertilizers also helps in getting good yield and quality. Plant nutrition is a term that takes into account the interrelationships of mineral elements in the soil or soilless solution as well as their role in plant growth. This interrelationship involves a complex balance of mineral elements essential and beneficial for optimum plant growth.

Nutrient deficiencies in plants are often made most evident by plant physiological responses. Nutrient deficiency symptoms tend to occur in three major patterns: localized to the younger tissues, localized to the more mature tissues, or widely distributed across the plant (Boroomand and Grouh, 2011) [15].

There are seventeen essential mineral nutrients are classified as macronutrients and micronutrients based on their plant requirements. There are nine macronutrients: Carbon (C),
Hydrogen (H), Oxygen (O), Nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and sulfur (S). The macronutrients, N, P, and K, are often classified as ‘primary’ macronutrients, because deficiencies of N, P and K are more common than the ‘secondary’ macronutrients, Ca, Mg, and S. The micronutrients include boron (B), chlorine (Cl), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), nickel (Ni) and zinc (Zn). Nitrogen is one of the most important nutrients needed by plants; it is an important element for the formation amino acids, it is essential for plant cell division, it is directly involved in photosynthesis, it is an important component of vitamins and it aids in the production of carbohydrates. Physiologically, N is mostly available to plants in the forms of ammonium and nitrate and preference for one of the two forms to be taken up by plants tend to be influenced by the plant species and soil conditions, including pH and soil temperatures. Fertilization programme in medicinal plants has two important objectives: high vegetative growth and high medicinal materials and increased medicinal value of a plant. Generally, N supply favour increased vegetative growth. Argyropoulou et al., [6] reported significant increase in plant height of Allium cepa by N fertilizers.

Growth

Hossain et al., (2007) [23] reported that N fertilizers increased the plant height of Aloe vera. Vetayasuporn, (2006) [44] reported significant increase in plant height of Allium cepa by P fertilizers. Renata et al., [40] 2012 and Kandil et al., [27] 2009 concluded that, the application of nitrogen fertilization significantly differentiated mean height of basal plants, which decreased with the increase of this nutrient’s dose and The applied nitrogen doses differently stimulated basal branching, and the greatest number of branchings (12.8 pcs per plant) was reported at medium and the highest nitrogen doses and also increased amount of NPK causes the increased number of basal branching. Rahul et al., 2016 [38] and Mastiholi (2008) [32] in coleus, reported that, there was a gradual increase in vine length with increase in NPK doses. It is evident that when there is more availability of nutrients, crop puts up better vegetative growth with this Nagappa Desai and S. Thirumala in coleus concluded that plant height, number of branches were found to be more in plants applied with FYM along with Bio fertilizers. Further enhances the soil fertility status as biofertilizers like Azatobacter, Phosphorus solubilizing bacteria and Arbuscular Mychorrizza fungi independently or in combination enhances the N and P status respectively.

Yield

The fresh and dry tuber yield was maximum in crops treated with organics combined with chemical fertilizers than the crop treated with organics alone. This increase in tuber yield might be due to the fact that vermicompost and FYM might have supplied higher amount of major and micronutrients this was confirmed by Sadashiv et al., (2014) [41]. According to Rahul et al., [38] the tuber yield followed the increasing trend with increase in nutrient dose up to a certain level (Tc: 15t FYM + 100: 50: 75 kg NPK per ha). Further increase in nutrient doses decreased the tuber yield. This may be due to more of vegetative growth and seed yield in increased nutrient doses which resulted in decrease in tuber yield. Kamlesh Ahirwar reported that the applied nitrogen level up to N200 proved highly beneficial producing fresh turmeric rhizomes up to 102.41 q/ha, the applied potassium levels, the crop responded significantly up to the highest K level of K200. At this K-level, the maximum rhizome yield was 99.28 kg/ha and A combination of 200 kg/ha each of N and K recorded maximum rhizome yield (318.35 q/ha). According to Aladakatti et al., 2012 [6] Higher stevia fresh biomass, fresh
leaf yield and dry leaf yield of stevia with higher N, P, and K nutrient levels could be attributed to more number of branches and leaves plant-1 of stevia due to higher plant height. Allam et al., 2001 [7] conducted research in Egypt showed a significant increase in dry leaf biomass yields of stevia when nitrogen fertilizer was increased from 10 to 30 kg N ha-1 wherein the dry leaves yield increased by 64 per cent compared to lower dose. Chalapathi et al., 1999 [16] reported that growth and yield of stevia increased significantly with increasing rates of N, P and K up to 60:30:45 kg ha-1 per crop with the highest dry leaf yield which was on par with 40:20:30 kg ha-1 per crop in sandy loam soils at Bangalore. Ingle et al., 2004 [24] reported that the yield of safed musali tuber increased progressively with the increase in the levels of fertilizer up to 30:60:30 kg NPK/ha and the application of 20 t/ha + 30:45:30 kg NPK/ha combination recorded maximum 6.05 t/ha dry tuber yield of safed musali. Vembu et al., 2010 [43] application of NPK @ 30:40:40 kg ha-1 recorded an increased root length of 26.67 cm, fresh root weight of 22.82 g/plant and dry root weight of 8.46 g/plant at harvest. The control recorded the lowest fresh (15.82 g/plant) and dry (5.72 g/plant) weight of root. Ragunath (1981); Rajasekara et al., (1982) [37, 39] also reported that application of NPK fertilizer increased the leaf and root yield of Periwinkle. Ishwar et al., 1994 [25] confirm an earlier study in which a consistent increase in this yield component was observed in isabagal with increase in soil N level. Ashraf et al., 2006 [5] in isabagal, a high level of N (90kgN/ha) proved to be detrimental to the growth and seed yield of isabagal. Although the optimum N level for this crop was 60 kg N/ha, in terms of cost-benefit ratio, 30 kg N/ha was a more suitable dose of N fertilizer from farmers’ perspectives. Reduction in N applications also may have a positive impact on energy balance and environmental pollution. Among the various levels of major nutrients, application of 200, 100 and 100 kg N, P2O5 and K2O/ha recorded the maximum plant height (109 cm), number of leaves (9.8/plant), length of leaf (62.8 cm), yield of green rhizome (0.53 g/plant) and (41 tonnes/ha).

Conclusion
Application of balanced level of essential nutrients to plants will increase the growth and yield of the crop. Combined application of N and P created favourable environment which increased uptake of nutrients from the soil for better growth and development. Synergistic effects of both N and P improved nutrient levels and enhanced plant growth by promoting the meristic activity, which favour plant growth and finally higher seed, straw and biological yields.

References
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