Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(3): 3110-3113
Received: 15-03-2018
Accepted: 20-04-2018

Rajbeer Singh
Division of Agronomy, Faculty of Agriculture SKUAST-K Kashmir, Jammu and Kashmir, India

Amjad Masood
Division of Agronomy, Faculty of Agriculture SKUAST-K Kashmir, Jammu and Kashmir, India

Zaffar Mahdi Dar
Division of Basic Sciences & Humanities, Faculty of Agriculture SKUAST- K Kashmir, Jammu and Kashmir, India

Malik Asif
Division of Basic Sciences & Humanities, Faculty of Agriculture SKUAST- K Kashmir, Jammu and Kashmir, India

Mushtaq A Mailk
Division of Basic Sciences & Humanities, Faculty of Agriculture SKUAST- K Kashmir, Jammu and Kashmir, India

Correspondence
Rajbeer Singh
Division of Agronomy, Faculty of Agriculture SKUAST-K Kashmir, Jammu and Kashmir, India

Integrated nutrient management in maize (*Zea mays* L.)

Rajbeer Singh, Amjad Masood, Zaffar Mahdi Dar, Malik Asif and Mushtaq A Mailk

Abstract
Integrated nutrient supply/management (INM) aims at maintenance or adjustment of soil fertility and plant nutrient supply to an optimum level for sustaining the desired crop productivity through all possible sources of plant nutrients in an integrated manner which include; maintenance or enhancement in soil productivity through a balanced use of fertilizers combined with organic and biological sources of plant nutrients. Soil fertility maintenance requires a balanced application of inorganic and organic nutrient sources. Sustainable agricultural productivity might be achieved through a wise use of INM. Integrated use of chemical and organic fertilizer on yield and yield components of maize is very crucial for assurance of food security though improvement of the stock of plant nutrients in the soils and the rapid uptake of plant nutrients, thus, limiting losses to the environment thus reduce inorganic (fertilizer) input cost. Different kinds of organic materials such as FYM, animal manures, green manures, crop residues, composts, and industrial wastes have been used in maize systems. Hence an attempt has been made in this review to elaborate the effects of INM on various growth parameters, nutrient uptake and yield of maize based on the available literature.

Key words: fertility, growth, Integrated, maize, nutrient

Introduction
Maize (*Zea mays* L.) is the most versatile crop with wider adaptability in varied agro-ecological conditions. It is an annual C4 plant belonging to the family poaceae with its origin Central America. Maize being one of the most important cereals crop in the world agricultural economy, it is cultivated throughout the world as it has highest genetic yield potential than any other cereals crop and there is no cereals on earth which has so immense potential and hence referred to as "Queen of cereals" or miracle crop (Ratuarary *et al*. 2013) [24]
It is a productive food plant and his highest potential for carbohydrate accumulation per unit area per day (Aldrich *et al*, 1975) [2]. In addition to being staple food for human being and feed for animal it provides valuable raw materials for various agro based industries in addition to its common usage as human food grains, corn oil, bakery products, forage and feed for livestock and poultry (Chaudhary, 1982). Moreover, starch of maize grain is also being used in textile, paper, paperboard etc. (Delorite and Ahlgren, 1967) [10]. In India maize is third most important food crop after rice and wheat and currently it is cultivated in an area 8.49 mha with production 21.28 mt having productivity 2507 kg ha. In India at present, about 35% of the maize produced in the country is used for human consumption, 25% each in poultry and cattle feed and 15% in food processing. It has multifarious uses and the diversity of environments under which it is grown is therefore unmatched by any other crops (Doswill *et al.* 1996). The predominant maize growing states that contribute more than 80% of total maize production are Andhra Pradesh (20.9%), Uttar Pradesh (6.1%), and Madhya Pradesh (5.7%) Himachal Pradesh (4.4%) apart from these states maize is also grown Jammu and Kashmir and northern states (www. Farmers.gov.in). the global area under organic production accounts more than 31mh (Yadav 2007) [28]. The future sustainability of the maize production will greatly depends on balanced fertilization of organic and inorganic fertilizers for optimum plant growth and nutrient supply for realizing yield potential.
It is widely accepted that neither use of organic manure alone nor chemical fertilizers can achieve sustainability of the yield under the modern intensive farming. To counter the detrimental effect of inorganic fertilizers, organic manure are available indigenously which improve soil health resulting enhanced crop yield. Maize being a heavy consumer of 'N' needs to be supplied with both inorganic and inorganic fertilizers to the crop productivity, grain yield, LAI, and TDM (kudatakar *et al.* 2005)

Effect of integrated nutrient management on growth parameters of maize

Integrated nutrient management practices in maize significantly increase vegetative growth up to harvest (Verma *et al*, 2006). Kannan *et al.* (2013) [14] reported that the integrated nutrient management practices including vermicompost and recommended dose of NPK gives best result with respect to plant height. Application of 100% recommended dose of fertilizers substitutes with bio fertilizers (Azotobactor + PSB) + green manuring with sunhemp + compost for obtaining better plant height (kalhapure *et al*. (2013). The application of recommended dose of fertilizers with azotobactor and phosphate solubilizing bacteria significantly increases plant height of maize (Dadarwal *et al.* 2009) [9]. Satyajeet *et al*. (2007) [28] showed that pearl millet hybrid recorded highest growth in terms of plant height over rest of the varieties along with 100% recommended dose (RD) in conjunction with vermicompost and biofertilizers. Reduction of 50% recommended dose of fertilizers along with vermicompost @10t ha significantly influenced the plant height of *kharif* rice as compared with 100% RDF and also under different combination of farm yard manure and mineral nutrition Barik *et al.* (2006) [5]. However, studies made by Hadda and Arora (2006) found maximum increases of 57.0% in plant height with the application of RDF (75%) + FYM at 10 t ha treatment on maize. Tetarwal *et al.* (2011) reported that the application of 150% RDF (N_{60}, $P_{22.5}$,) Produced significantly higher plant height on, maize. Moreover, Haque *et al.* (2012) opined that 75% recommended dose of fertilizers + vermicompost @ 2 t ha recorded tallest plant height (2.40 and 2.19) at harvest. Karforma *et al.* (2012) [16] showed that of 50% RDN through FYM + 50 %RDF through chemical fertilizers and Azotobactor significantly effect on improving the growth attributes like leaf area index of fodder maize. A trend of higher growth parameters can observed with the use of vermicompost and industrial fertilizers in comparison to classical compost and the finding made by Kannan *et al*. (2013) [14] confirms that the integrates nutrient management practices including vermicompost and recommended dose of NPK gives best result with respect to growth parameters like leaf area index. Banerjee *et al.* (2006) [4] reported that the highest leaf area which was found on application of N_{120} and $P_{60\ at}$ par with $N_{120\ and}$ $P_{30\ VAM}$. Ravi *et al*. (2012) [25] reported that addition of well decomposed farm yard manure to soil with recommended dose of fertilizers significantly increased total dry matter accumulation with integration of organic and inorganic fertilizers. Agarwal *et al.* (2005) revealed that the application of vermicompost significantly increased the biomass production. The application of vermicompost @ 2.5 t ha-^{1} resulted in significantly higher dry matter production at harvest (314.67 g plant). Karforfma *et al.* (2012) [16] showed that of 50% RDN through FYM +50% RDF through chemical fertilizers and Azotobactor significantly effect on improving the growth attributes like crop growth rate of fodder maize.

Effect of integrated nutrient management practices on yield attributes of maize

Integrated nutrient management practice including vermicompost and recommended dose of NPK showed its best results with respect to yield parameters like seed weight per cob Kannan *et al.* (2013) [14]. Kumar (2009) [26] reported that the yield attributes significantly difference in seed weight per cob maize obtained by more amounts of nutrients supplied through organics as evidence by their nutrient content. The result showed that incorporated chemical and biological fertilizer obtained highest kernel number per cob compared to sole application of them Ramansyha *et al.* (2013). Kannan *et al.* (2013) [14] reported that integrates nutrients management practices including vermicompost and recommended dose of NPK is best with respect to yield parameters like number of seeds per cob. The maximum number of cobs per plant was recorded in treatment where Urea + FYM were applied and it was significantly higher followed by urea alone (Saha *et al.* 2008) [29]. Joshi *et al*. (2013) [13] opined that the crop produced significantly higher number of cob per plant with conjoin application of recommended dose of NPK +10 t FYM ha^{-1} compared to either inorganic fertilizer alone or organic sources or 50% of recommended dose of inorganic fertilizers. Integrated nutrient management practice on significantly increases the yield components like hundred seed weight (Sujatha *et al.* 2008) [34]. Combined application of recommended dose of fertilizers with farm yard manure significantly affected the 1000 seed weight Sharif *et al.* (2004) [30] and vermicompost and recommended dose of NPK use as an integrated manner recorded highest yield attributes *viz* 100 seed weight compared to the other treatments Kannan *et al. (*2013) [14]. The application of farm yard manure @ 10 t ha^{-1} economical (Mehta and Shaktawat, 2002) [22] and addition of well decomposed farm yard manure to soil with recommended dose of fertilizer significantly increased the cob length of maize with integration of organic and inorganic fertilizers. Judicious combination of organic and inorganic fertilizers helps to maintain soil fertility which leads to increases the yields attributes such as girth of cob (Kumar *et al.* 2007) [19]. Pattanashetti *et al.* (2002) [23] worked out the effect of organic amendments and inorganic fertilizers (100%, 75%, and 50% recommended dose of fertilizer) and viewed that the yields of maize and soybean under intercropping system and compared to those of sole cropping.

Effect of integrated nutrient management practices on yield of maize

Use of high yielding cultivars and chemical fertilizer enhanced yield and posed adverse effect on productivity and fertility of soil to overcome this situation, agricultural scientist have advocated the use integrated nutrient management and soil conditioners. Karki *et al*. (2005) [17] showed the 120 kg N +10 t farmyard manure + 5 kg zinc ha^{-1} can recorded the highest seed yields of maize were statistically at par with yield obtained on application of recommended dose of fertilizers (120:26.2:41.5 Kg NPK ha^{-1}). Joshi *et al.* (2013) [13] opined that the crop produced significantly higher seed yields with conjoin application of recommended dose of NPK + 10 t FYM ha^{-1} compared to either inorganic fertilizers alone or organics sources or 50% of recommended dose of inorganic fertilizers. Mohammadi *et al.* (2012) found that corn yields influenced by row spacing and plant density. Application of vermicompost 1.5 ton per hectare recorded significantly highest straw (6031 kg ha^{-1}) yields, however, application of 1.0 t vermicompost ha^{-1} remained equally effective in straw yield (Meena *et al.* 2007). The maximum stover yield was recorded with application of vermicompost @ 2.5 t ha^{-1} when compared to rest of treatments. Harvest index- the application of farm yard manure @ 10 t ha^{-1} (Singh *et al.* 2011) enriched with 150% recommended dose of fertilizers recorded significantly increased the harvest index (35%) over rest of the treatments.

References

1. Agrawal SB, Singh A, Dwivedi G, Singh A. Effect of vermicompost, farmyard manure and chemical fertilizers on growth and yield of wheat (*Triticum aestivum* L.) var. HD 2643. Plant Archives. 2003; 3(1):9-14.
2. Aldrich SR, Scott WO, Leng ER. Modern corn production. 2ndEd.Champaign, IL, USA, A & L Publications, 1975, 213
3. Arora S, Hadda MS. Soil moisture conservation and nutrient management practices in maize-wheat cropping system in rain-fed North-western tract of India. *Indian* Journal of Dryland Agriculture Research and Development. 2003; 18:70-74.
4. Banerjee M, Rai RK, Srivastava GC, Maiti D, Dhar S. Influence of nitrogen and phosphate solubilizing bacteria and phosphorus sources on growt, Chlorophyll and yield of maize. Indian Journal of Plant Physiology. 2006; 11(4):373-378.
5. Barik AK, Das A, Giri AK, Chattopadhyay GN. Effect of integrated plant nutrient management on growth, yield and production economics of wet season rice (*Oryza sativa*). Indian Journal of Agriculture Science. 2006; 76(11):657-60.
6. Choudhary SK, Singh RN, Singh UPK, Choudhary PR, Pal V. Effect of vegetables intercrops and planting pattern of maize on growth, yield and economics of winter maize (*Zea mays* L.) in Eastern Uttar Pradesh. Environment and Ecology. 2014; 32(1):101-105.
7. Choudhary VK, Kumar SP, Bhagawati R. Production potential, soil moisture and temperature as influenced by maize- legume intercropping. International Journal of Science and Nature. 2012; 3(1):41-46.
8. Choudhary VK, Kumar SP, Bhagawati R. Response of tillage and in situ moisture conservation on alteration of soil and morpho physiological differences in maize under Eastern Himalayan Region of India. Soil and Tillage Research. 2013; 134:41-48.
9. Dadarwal RS, Jain NK, Singh D. Integrated nutrient management in babycorn (*Zea mays*). Indian Journal of Agriculture Science. 2009; 79:1023-1025.
10. Delorite RJ, Ahlgren HL. Crop Production. 3rd edition, Printice Hall, Inc. Englwood Cliffs, New Jersy, 1967, 34-35.
11. Hadda MS, Khera KL, Kukal SS. Soil and water conservation practices and soil productivity in North-Western sub-mountainous tract of India: A review. Indian Journal of Soil Conservations. 2000; 28:187-192.
12. Haque S, Patra PS, Saha A. Growth attributes cob yield and economics of maize (*Zea mays* L.) cultivars as affected by integrated nutrient management under terai region of West Bengal. Indian Journal of Agricultural Research. 2012; 46(1):42-47.
13. Joshi E, Nepalia V, Verma A, Singh D. Effect of integrated nutrient management on growth, productivity and economics of maize (*Zea mays* L.). Indian Journal of Agronomy. 2013; 58(3):434. 221
14. Kannan RL, Dhivya M, Abinaya D, Lekshmi KR, Krishnakumar S. Effect of integrated nutrient management on soil fertility and productivity in maize. Bulletin of Environment, Pharmacology and Life Sciences. 2013; 2(8):61-67.
15. Kar PP, Barik KC, Mahapatra PK, Garnayak LM, Rath BS, Bastia DK *et al*. Effect of planting geometry and nitrogen on yield, economics and nitrogen uptake of sweet corn (*Zea mays* L.). Indian Journal of Agronomy. 2006; 51(1):43-45.
16. Karforma J, Ghosh M, Ghosh DC, Mandal S. Effect of integrated nutrient management on growth, productivity, quality and economics of fodder maize in rainfed upland of terai region of West Bengal. International Journal of Agriculture, Environment and Biotechnology. 2012; 5(4):419.
17. Karki TB, Kumar A, Gautam RC. Influence of integrated nutrient management on growth, yield, content and uptake of nutrients and soil fertility status in maize (*Zea mays* L.). Indian Journal of Agriculture Science. 2005; 75(10):682-685.
18. Kumar A, Dhar S. Evaluation of organic and inorganic sources of nutrient in maize (*Zea mays* L.) and their residual effect on wheat (*Tricticum aestivum*) under different fertility levels. Indian Journal of Agriculture sciences. 2010; 80(5):364-71.
19. Kumar A, Rana KS. Performance of pigeon pea + green gram intercropping system as influenced by moisture conservation practices and fertility level under rainfed conditions. Indian Journal of Agronomy. 2007; 52(1):31-35.
20. Kumar A, Thakur KS. Effect of integrated nutrient management on promising composite maize (*Zea mays* L.) varieties under rain-fed mid-hill conditions of Himachal Pradesh. Indian Journal of Agricultural Sciences. 2004; 74:40-42
21. Meena OP, Gaur BL, Singh P. Effect of row ratio and fertility levels on productivity, economics and nutrient uptake in maize (*Zea mays* L.) and soybean intercropping system. Indian Journal of Agronomy. 2006; 51(3):178-182.
22. Mehta YK, Shaktawat MS. Response of maize to various sulphur, phosphorus and FYM levels. Extended summaries In Second International Agronomy Congress on Balancing Food and Environmental Security-A Continuing Challenge. 2002; 1:200-201.
23. Pattanashetti VA, Agasimani CA, Babalad HB. Effect of manures and fertilizers on yield of maize and soybean under intercropping system. Journal of Maharashtra Agricultural Universities. 2002; 27(2):206-207.
24. Rautaray SK, Ghosh BC, Mittra BN. Effect of fly ash, organic wastes and chemical fertilizers on yield, nutrient uptake, heavy metal content and residual fertility in rice mustard cropping sequence under acid lateritic soils. Bioresource Technology. 2013; 90:275-283.
25. Ravi N, Basavarajappa R, Chandrashekar CP, Harlapur SI, Hosamani MH, Manjunatha MV. Effect of integrated nutrient management on growth and yield of quality protein maize. Karnataka Journal Agriculture Science. 2012; 25(3):395-396.
26. Ravikumar HS. Effect of FYM and bio-digested liquid manure on growth and yield of groundnut under rainfed condition. M.Sc. (Agri.) thesis, University of Agriculture Science. Bangalore, 2009.
27. Saha M, Mondal SS. Influence of integrated plant nutrient supply on growth, productivity and quality of baby corn (*Zea mays* L.) in Indo-Gangetic Plains. Indian Journal of Agronomy. 2006; 51(3):202-205.
28. Satyajeet RK, Nanwal K, Yadav VK. Effect of integrated nutrient management in nitrogen, phosphorus and potassium concentration, uptake and productivity in pearl millet. Journal of Maharastra Agricultural Universities. 2007; 32:186-188.

29. Shah STH, Zamir SIM, Wasee M, Ali A, Tahir M, Khalid WB. Growth and yield response of maize (*Zea mays* L.) to organic and inorganic sources of nitrogen. Pakistan Journal Life and Social Science. 2008; 7(2):108-111.
30. Sharif MM, Ahmed MSS, Khattak RA. Effect of organic and inorganic fertilizers on the yield and yield components of maize. Pakistan Journal Agriculture Engineering and Veterinary Science. 2004; 20:11-15.
31. Sharma AR, Singh R, Dhyani SK, Dube RK. Moisture conservation and nitrogen recycling through legume mulching in rainfed maize (*Zea mays* L.)-wheat (*Triticum aestivum*) Cropping System. Nutrient Cycling in Agro ecosystems. 2010; 87(2):187-197.
32. Sharma PB, Singh VB. Productivity and economic viability of different intercrop combinations in Tawa command area. Advances in Plant Sciences. 2008; 21(2):441-442.
33. Sharma P, Abrol V, Sankar GRM, Singh B. Influence of tillage practices and mulching options on productivity, economics and soil physical properties of maize (*Zea mays* L.)-wheat (*Triticum aestivum*) system. Indian Journal of Agricultural Sciences. 2009; 79(11):865-870.
34. Sujatha MG, Lingaraju BSM, Palled YB, Ashalatha KV. Importance of integrated nutrient management practices in maize under rainfed condition. Karnataka Journal of Agriculture Science, 2008, 21(3).
35. Tetarwal JP, Baldev R, Meena DS. Effect of integrated nutrient management on productivity, profitability, nutrient uptake and soil fetrtility in rainfed maize (*Zea may*s L.). Indian Journal of Agronomy. 2011; 56(4):373-376.
36. Yadav AK, Gahlot D. Sustained soil health and better profitability. The Hindu Sur Indian Agriculture, 2011, 31-32.
37. Yadav RL, Yadav DV, Duttamajumdar SK. Rhizospheric environment and crop productivity: A review. Indian Journal of Agronomy. 2011; 53(1):1-17.