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# An Integrated Nutrient Management (Inm) In Rain-Fed Maize

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## Abstract:

Sustainable agricultural productivity can be achieved through the wise use of integrated nutrient management. Integrated use of chemical and organic fertilizer on yield and yield components of maize is very crucial for assurance of food security. Maize, also known as "Corn," is one of the most versatile emerging cash crops having wider adaptability under varied climatic conditions. It is called the queen of cereals globally. In India, maize or corn is the third most important food cash crop after wheat and rice. The crop is grown year-round in all states of the nation for a variety of purposes. To provide food security, integrated application of chemical and organic fertilizers on maize production and yield components is essential. By optimizing the benefit from all potential sources of plant nutrients in an integrated manner, integrated nutrient supply/management (INS) aims to maintain or enhance soil productivity through a balanced use of fertilizers combined with organic and biological sources of plant nutrients. It also aims to maintain or adjust soil fertility and plant nutrient supply to an optimal level for sustaining the desired crop productivity. In maize systems, a variety of organic resources have been employed, including crop leftovers, composts, vermicompost, bio compost, animal manures, green manures, and industrial wastes.

**Keywords:** chemical fertilizer, organic fertilizer, integrated nutrition management utilizing biofertilizer.

## Introduction:

One of the most significant cereal crops grown for food, feed, and industrial raw materials worldwide is maize (Zea mays L.), which is rated third in terms of cereal production after wheat and rice. Because of its greater adaptability, it is grown in a variety of agro-ecological zones. According to reports, Andhra Pradesh leads all the producing states in India in terms of maize production, accounting for 21% of the total. Karnataka comes in second with 16%, Rajasthan with 10%, Maharashtra and Bihar with 9% each, and Madhya Pradesh and Uttar Pradesh with 6% each (P Chennankrishnan and K Raja, 2012) [12]. Low yield productivity is mostly caused by improper fertilizer management; therefore, to attain maximum crop productivity, fertilizer management is necessary. This involves the prudent application of organic sources, biofertilizers, and micronutrients. Moreover, one of the key elements affecting the growth and productivity of the maize crop is the control of fertilizer. (Ghaffari, *et al*., 2011) [1].

After sugar cane, maize is said to be the most demanding crop in terms of nutrients needed for both high growth and production potential. In actuality, organic nutrients maintain and/or enhance the health of the soil in addition to giving plants nutrition. In order to retain and maintain soil productivity, crop fields can benefit from integrated nutrient management (INM), which is the prudent application of both organic and inorganic fertilizer sources. But problems like rising costs for inorganic fertilizers and declining soil fertility and productivity can be solved by applying the right amount of nutrients in the right combination, either through organic and inorganic sources separately or in combination. Therefore, the fertility and productivity of the soil may be maintained with the careful application of these mixtures.

## Materials and Methods:

Reviews of previous research on various aspects of integrated nutrition management in maize were gathered in September 2017. The goal of this review study was to understand the effects of various nutrient management techniques on maize growth, yield, quality produce, and nutrient uptake. A review of the pertinent and significant published literature on maize has been conducted.

## Results and discussion:

Attempts are, therefore made to present a brief summary of work carried out in India and abroad relating to the INM under reviewed under given headings.

## Effect of integrated nutrient management on maize Growth:

Louraduraj (2006) [8] conducted a field trial on clay loam soil in Coimbatore, Tamil Nadu, during the 2002–2003 rabi season. The results showed that, in comparison to other treatment combinations, the application of 100% RDF (135–62.5–50 kg N–P–K/ha) along with 5.0 t/ha vermicompost significantly increased plant height, dry matter accumulation, and leaf area index in maize.

Khadtare *et al*. (2006) [7] conducted research at the college farm of Anand Agricultural University in Anand, Gujarat, during the 2005–06 rabi season. The results showed that, in the treatment RDF (150–50–00 kg N–P–K /ha), significantly higher values were recorded in terms of cob girth, cob length, and green cob weight. These were followed by 75% RDN + 25% N through vermicompost (VC) made from Parthenium hysterophorus L. and 75% RDN + 25% N through VC made from Amaranthus spinosus L.

The study, which was carried out on maize during the rabi seasons of 2006–07 and 2007–08 at the Brahmanand Mahavidyalaya Agricultural Research Farm in Hamirpur, Uttar Pradesh, showed that the application of 100 kg N/ha along with 7.5 t FYM/ha significantly influenced the plant height, leaf area index, and the number of days to maturity and silking. (Verma *et al*. 2012) [21].

Shilpashree *et al.* (2012) [15] conducted a field study during the 2009 kharif at the College of Agriculture, UAS, Dharwad (Karnataka) and found that applying 100% RDF (100-50-25 kg N-P-K/ha) + 7.5 t/ha FYM increased the amount of dry matter accumulation, plant height, number of leaves per plant, leaf area, and leaf area index of maize.
In the rabi seasons of 2012 and 2013, Kannan et al. (2013) [6] conducted a field study on maize at Manakkadavu, Pollachi, (Tamil Nadu) and discovered that the application of vermicompost @ 5 t/ha + RDF (120-60-00 kg N-P-K/ha) significantly increased plant height and leaf area index as compared to control.

Joshi *et al.* (2013) [3] carried out an experiment in the kharif season of 2010 at the Instructional Farm, Rajasthan College of Agriculture, Udaipur, Rajasthan, to investigate the impact of integrated nutrient management on the growth, productivity, and economics of maize. They proposed that the maximum plant height, dry matter output, and leaf area index were 96.5% greater than the control when RDF (120-60-30 kg N-P-K/ha) + FYM @ 10 t/ha was used.

In order to determine the most effective and economical combination of various organic and inorganic sources of nutrients to increase the productivity of hybrid maize (Zea mays L.), a field experiment was carried out at the Breeder Seed Production farm of Mahatma Phule Krishi Vidyapeeth, Rahuri (Maharashtra) for two consecutive kharif seasons in 2010 and 2011. Kalhapure *et al.* (2013) [4] discovered that the application of 25% RDF (30-15-15 kg N-P-K/ha) + biofertilizers (Azotobacter+ PSB) + green manuring with sunnhemp + compost resulted in significantly taller plants and maximum total plant dry matter accumulation.

Iqbal *et al*. (2014) [2] conducted an experiment on sandy clay loam soil in the Department of Agronomy at the University of Agriculture, Faisalabad (Pakistan) to assess the impact of integrated nitrogen management in maize during the 2012 Rabi season. They reported that when 75% N from urea and 25% N from poultry manure were applied, the highest plant height and number of leaves per plant were seen, which was comparable to applying 100% N from urea.

Evaluated the effects of integrated nitrogen management in maize during the 2012 Rabi season on sandy clay loam soil in the Department of Agronomy at the University of Agriculture, Faisalabad (Pakistan). According to their findings, the greatest plant height and leaf count were observed when 75% N from urea and 25% N from poultry manure were applied; this was equivalent to applying 100% N from urea. (Shinde *et*

*al*. 2014) [16].

Nagavani and Subbian (2014) [11] conducted a field study on hybrid maize at the irrigated upland farm of Tamil Nadu Agricultural University, Coimbatore (Tamil Nadu), during the kharif and rabi seasons of 2008 and 2009. The findings showed that applying 50% RDF through poultry manure + 50% RDF through inorganic fertilizers, followed by 50% RDF through vermicompost + 50% RDF through inorganic fertilizers, significantly increased the growth parameters of hybrid maize, including plant height and LAI.

Maske *et al*. (2015) [9] carried out an experiment in Parbhani, Maharashtra, during the rabi season of 2005–2006. The results showed that the application of 100% RDF (120–60–40 kg N–P–K/ha) + 10 t FYM/ha recorded the highest growth metrics, such as plant height and dry matter accumulation per plant of maize.

## Yield attributes and yield

Louraduraj (2006) [8] carried out an experiment at Coimbatore, Tamil Nadu, using rabi maize from 2002 to 2003. He observed that when 100% RDF (135-62.5-50 kg N-P-K/ha) and vermicompost (5 t/ha) were applied, the grain production was noticeably higher than when other treatment combinations were used.

Khadtare *et al*. (2006) [7] conducted research during the 2005–06 rabi season at the college farm of Anand Agricultural University, Anand (Gujarat), and found that significantly higher values were recorded in terms of green cob yield and green fodder yield in treatment RDF (150–50–0 NPK/ha), followed by 75% RDN + 25% N through VC prepared from Parthenium hysterophorus L. and 75% RDN + 25% N through VC prepared from Amaranthus spinosus L.

Pawar and Patil (2007) [14] documented during the 2004 rabi season in sandy loam soil at the University of Agricultural Science, Dharwad (Karnataka). The application of vermicompost @ 5 t/ha combined with 100% RDF (120-60-40 kg N-P-K/ha) resulted in noticeably greater grain and straw yields in maize compared to other treatments.

In 2008–09, Tetarwal *et al.* (2011) [20] conducted a field experiment in rainfed maize at Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, and found that application of 100% RDF (40–15 kg N–P/ha) + 10 t/ha FYM produced higher yields of grains per cob, cobs per plant, and biological yield compared to other treatments.

In the rabi seasons of 2006–07 and 2007–08, an experiment was set up at the Brahmanand Mahavidyalaya, Agricultural Research Farm, Hamirpur, Uttar Pradesh, according to Verma *et al*. (2012) [21]. The researchers observed that the application of 100 kg nitrogen/ha of inorganic fertilizer together with 7.5 t FYM/ha resulted in considerably increased yield features such as cob diameter, weight of cobs per plant, and grain and straw yields.

A study on maize was conducted in Udaipur, Rajasthan, during the 2010 kharif season, according to Joshi *et al.* (2013) [3]. They proposed that 100% RDF (120-60-30 kg N-P-K/ha) + FYM @ 10 t/ha will provide maximum values for practically all yield metrics, including number of cobs per plant, test weight, cob weight, and grain weight per cob.

Kannan*et al.* (2013) [6] conducted a field study on maize at Manakkadavu, Pollachi, (Tamil Nadu) during Ramadan 2012 and 2013. The researchers discovered that the use of vermicompost @ 5 t/ha in conjunction with 100% RDF (120-60-00 kg N-P-K/ha) demonstrated its superiority in terms of yield parameters, such as yield and the number of grains per cob and 100 seed weight.

In a field experiment done in Parbhani, Maharashtra, during the rabi seasons of 2004–2005 and 2005–2006, Shinde *et al.* (2014) [16] discovered that the maximum cobs/plant, grain yield, and straw yields of maize were obtained with the application of 100% RDF (120–60–40 kg N–P–K/ha) + 10 t FYM/ha.

In their evaluation of a field experiment conducted on rabi maize in 2010–11 at the experimental field of the Narendra Dev University of Agriculture and Technology, Kumarganj, Faizabad (Uttar Pradesh), Pandey and Avasthi (2014) [13] discovered that the yields of grains and straw were higher in RDF (120–60–40 kg N–P–K/ha) + FYM 10 t/ha.

Nagavani and Subbian (2014) [11] conducted a field experiment at the irrigated upland farm of Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, to assess the integrated use of organic and inorganic sources of nutrients on the growth, yield, and economics of hybrid maize during the kharif and rabi seasons of 2008 and 2009. They found that a significant increase in yield components, grain and straw yields of hybrid maize were recorded with the application of 50% RDF through poultry manure + 50% RDF through inorganic fertilizers, followed by 50% RDF through vermicompost + 50% RDF through inorganic fertilizers.

Maske *et al*. (2015) [9] carried out the experiment in Parbhani, Maharashtra, during the rabi season of 2005–2006. The results showed that the application of 100% RDF (120–60–40 kg NPK/ha) + 10 t FYM/ha recorded the highest yield attributes, namely cobs per plant, 1000–grain weight, grain yield, and straw yield of maize.

## Nutrient content, uptake and soil status:

In the 2005–06 season, a field experiment was carried out on the medium calcareous soil of the Instructional Farm at Junagadh Agricultural University, Junagadh (Gujarat), to investigate how the nitrogen and vermicompost levels affected the growth of rabi maize (Zea mays L.). When compared to the control and 80 kg N/ha + 1.5 t vermicompost/ha, the application of 120 kg N/ha + 1.5 t vermicompost/ha resulted in noticeably better nutritional content and absorption. (Meena *et al.* 2007) [10].

During the kharif seasons of 2002–03 and 2003–04, Tripathi *et al.* (2007) worked on maize at Gajraula (Uttar Pradesh). After crop harvest, they found that applying bio compost at a rate of 5 t/ha together with 75% N and P through fertilizer (100% RDF 120-60-60 kg N-P-K/ha) increased the amount of accessible organic carbon and N in the soil.

During the 2004–05 kharif season, Singh and Nepalia (2009) conducted an experiment at the Rajasthan College of Agriculture in Udaipur, Rajasthan. According to their findings, applying vermicompost at a rate of 5 t/ha along with 100% RDF (90–40 kg N–P/ha) to maize enhanced the soil's organic carbon content and N and P status compared to the control.

At Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, Tetarwal *et al.* (2011) [20] initiated a field experiment in 2008–09; the experiment's findings indicated that applying 100% RDF (40–15–00 kg N–P–K/ha) + 10 t/ha FYM registered maximum NPK uptake by maize and available N and P status to the tune of 1.28 and 14.89%, respectively, over initial status of soil fertility.

A field experiment with kharif maize was conducted in 2007–2008 at the Rajasthan College of Agriculture's Instructional Farm of Agronomy in Udaipur, Rajasthan, according to Singh *et al.* (2012) [19] .The application of 100% RDF (120-26.21-33.2 kg N-P-K/ha) in conjunction with FYM @ 10 t/ha resulted in considerably increased nitrogen and phosphorus uptake by grain and straw, as well as higher overall crop intake when compared to the control.

Two successive kharif seasons in 2010 and 2011 saw a field trial on hybrid maize at the Breeder Seed Production farm of Mahatma Phule Krishi Vidyapeeth, Rahuri (Maharashtra). They found that applying 25% RDF (30-15-15 kg N-P-K/ha) + biofertilizers (Azotobacter + PSB) + green manuring with sunnhemp + compost resulted in noticeably higher levels of organic carbon, accessible N, P2O5, and K2O content in the soil. (Kalhapure and others, 2013) [4].

In their evaluation of a field experiment conducted on rabi maize in 2010–11 at the Narendra Dev University of Agriculture and Technology's experimental field in Kumarganj, Faizabad, Uttar Pradesh, Pandey and Avasthi (2014) [13] discovered that the application of RDF (120–60–40 kg N–P–K/ha) + FYM 10 t/ha resulted in the highest soil porosity, CEC, organic carbon, available N, P2O5, and zinc levels.

## Quality :

Singh *et al.* (2011) conducted a field experiment on sandy loam soil in Varanasi, Uttar Pradesh, during the pre-kharif season of 2004–05. They found that applying 75% RDF (100% RDF 180–38.7–74.7 kg N–P–K/ha) + 25% FYM did not significantly affect the protein content of the grain of maize.

In the rabi seasons of 2006–07 and 2007–08, an experiment was set up at the Brahmanand Mahavidyalaya Agricultural Research Farm in Hamirpur, Uttar Pradesh, according to Verma *et al*. (2012) [21] They discovered

that applying 100 N kg/ha of inorganic fertilizer along with 7.5 t FYM/ha greatly increased the protein content (8.20%) of the grain of maize.

In a field experiment conducted in Parbhani, Maharashtra, during the rabi seasons of 2004–2005 and 2005–2006, Shinde *et al.* (2014) [16] found that applying 100% RDF (120–60–40 kg N–P–K/ha) + 10 t FYM/ha resulted in the greatest protein yield and percentage values of maize.

In order to assess the impact of integrated nitrogen management in maize during the 2012 rabi season, Iqbal *et al*. (2014) [2] conducted an experiment on sandy clay loam soil at the Department of Agronomy, University of Agriculture, Faisalabad (Pakistan). When 75% of the nitrogen from urea and 25% of the nitrogen from poultry manure were applied, the maximum amount of crude protein (%) of maize (8.63%) was reached in 100 RDN from urea. This resulted in a crude protein of 8.46%.

## Conclusion:

Based on the discussion, it can be concluded that applying organic and inorganic fertilizers in the right amounts to maize will increase its growth, yield, quality, and nutrient uptake. The findings demonstrated the multifunctional benefits of integrated nutrient management strategies for maize crops, including improved crop productivity and soil fertility in sustainable ways. It is widely held that applying both organic and inorganic fertilizer together will boost synchrony, improve fertilizer efficiency, and lessen any potential environmental issues.

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