Effect of nitrogen foliar application in different concentration and growth stage of corn (Hybrid 704)

Hamideh Shirvani Sarakhsi, Mehrdad Yarnia, Reza Amirnia

ABSTRACT

To evaluate the effects of urea foliar application in different concentration on grain filling period and yield of corn an experiment was conducted in split plot on the basis of randomized complete block design with three replications during growing season of 2008. Treatments were three levels of nitrogen foliar application concentration (%3, %5, %7) and seven stages of foliar application (control, tasseling, bearing, beginning of seed filling, seed pasty, beginning of seed filling + tasseling, all of the stages). Analysis of data showed that using different concentration increased leaf area index and stem diameter significantly %5, %1 level and effects of different methods in harvest index and stem diameter at %5, %1 and interaction effect of them on height, leaf dry weight, yield, fertilizer use efficiency, row in ear, seed in row, seed in ear and shoot dry weight affected significantly at %1 level of probabilities. Result showed that N foliar application increased quality in compared with control treatment. The highest leaf area index (3414 cm²) in %3 NFAC, height (202.5 cm) in all of the stages with %3 NFAC, harvest index (59.9%) in tasseling stage, leaf dry weight (37.5 g) in beginning of seed filling + tasseling with %5 NFAC, yield (2037 g.m⁻²) in tasseling with %3 NFAC, fertilizer use efficiency (1.117 kg.kg⁻¹) in seed pasty with %3 NFAC, row in ear (15.3) in beginning of seed filling with %3 NFAC, seed in row (51.83) in all of the stages with %3 NFAC, seed in ear (714.1) in all of the stages with %3 NFAC, shoot dry weight (184.3 g.) in tasseling with %3 NFAC, stem diameter (2.505 cm) in 3% NFAC were obtained.

Key words: Corn, N concentration, stage, foliar application

Introduction

Corn (Zea mays L.) is perhaps more than any other crop of worldwide importance, a product of human selection and improvement [15]. Corn is the most important "coarse grain" crop (i.e., a crop used mostly as livestock feed rather than as human food) in the world [29]. The nutrients absorb by roots and shoot but it’s not enough for plants [34]. There for, farmers use foliar application of method that it dependent on conditions. Foliar application often is effective and economic method for quality improvement of nutrients in the plants [28]. Foliar application of nutrients increases yield of plants in compare with soil application [4]. It has been reported that foliar application cause nutrients move terminal leaves to depth roots also, the other idea is spraying nutrients increase absorption in the plants at the air high wet [31]. The objective of the response of both grain yield and grain nitrogen concentration of wheat (Triticum aestivum L.), narrow leafed lupin (Lupinus angustifolius L.) and pea (Pisum sativum L.) was to similar source reduction during grain filling.
Grain yield was differentially (p<0.01) decreased by the source reduction in lupin (98%), wheat (63%) and pea (26%) on the other hand, source reduction positively affected (p<0.05) grain nitrogen concentration in wheat (66%) and pea (18%) but negatively affected lupin (40%). The higher sensitivity of grain yield compared to that of grain nitrogen yield was the cause of the positive effect of the lower source-sink ratio recorded in wheat and pea. In contrast, source shortage in lupin decreased grain nitrogen concentration probably as result of the quick response of grain growth to source limitation [26]. The effect of application of nitrogen fertilizer and herbicides was significant on weed cover score and weed dry weight of the crop at 6 WAT [18]. In during grain filling and its relation to physiological maturity in corn below 70% ear moisture, dry-weight per kernel increased linearly with decreasing ear moisture. Ear moisture at physiological maturity was also influenced by genotype, with values ranging from 34.3 to 44.5% for the 18 genotypes studied [10]. Labrana and Araus [20] found that effect of foliar application of silver nitrate and ear removal on carbon dioxide assimilation in wheat flag leaves during grain filling is that foliar application of silver ion delayed flag leaf senescence and grain ripening in wheat plants. The research of effect of soil and foliar application of N during pod development on the yield of soybean plants viewed that application of at pod filling stag either to the soil or to the foliage increased fruit set, weight of pools and the yield of oil and protein in seed. The most effective treatment was a foliar application of 1% urea [5]. Effect of fungicide and foliar fertilizer application to winter wheat at grain yield and quality is that compared to the strebrolin fungicide application the foliar fertilizer led to a longer delay of the flag leaf senescence and higher bread-making quality [6].

Effect of foliar application of an olive is that foliar application increases in grain protein concentration of about 22%, grain starch concentration of about 5%, grain yield of about 4% [32]. The effect of late season urea spraying on grain yield and quality of winter wheat is that foliar urea (30 kg N ha⁻¹), all cultivars increased grain yields to a similar extent (by an average of 7.8% or 509 kg ha⁻¹) primarily due to an increase in the 1000 kernel weight. Foliar urea (194 kg N ha⁻¹) increased grain yields averaged 24.9% (1680 kg ha⁻¹) higher than those at low N late [33]. Chauhan et al [12] reported that foliar sprays of concentrates urea induced defoliation to wheat increased mean wheat yield by 29% from 2.4 t.h⁻¹ to 3.1 t.h⁻¹. Application of all rates of nitrogen (130, 100, 70 and 40) fertilizer resulted in significantly higher crop vigor score than the control (0 KgNha⁻¹) in both the years and the combine data [18]. Also, Abad et al [1] reported that N fertilization and foliar were effects on durum wheat yield and quality about 50 kg.ha⁻¹ of N was applied as a urea foliar spray at the flag leaf stage. The average grain yield ranged from 2422 to 5730 kg.ha⁻¹ depending on the year and location.

The purpose of this study was effect of urea foliar application in different concentration on grain filling period and yield of corn, there for in this condition we tried to know N application of best stage and changeable important characteristic.

Materials and methods
A split plot experiment based on randomized complete block design with three replications was conducted during growing season of 2008 at Islamic Azad University, Tabriz branch, agricultural research station in Tabriz, North West of Iran. Treatments consisted of three N foliar application concentration (NFAC) (3%, 5%, 7%) as the first factor and seven application stage (control, tasseling, earing, beginning of seed filling, seed pasty, tasseling + seed filling, all stages) as the second factor. Each plot consisted of 4 rows, 5 m long, 2.4 m and 60 cm apart. Seeds were placed in to soil to a depth of 4 cm and 20 cm apart on the rows. Planting did the end of May.

Based on the results of soil analysis, 300 kg ha⁻¹ urea, 150 kg ha⁻¹ triple super phosphate and 100 kg ha⁻¹ potassium sulfate were applied to soil as the starter fertilizer prior to planting when the plants were at 4-6 and 10-12 leaf stages, thinning, weeding and nitrogen top dressing were performed. Plots that were used as control were sprayed with pure water to wash overlapping N application. N Foliar application in different concentration (%3, %5, and %7) did in different growth stage in corn (704 Hybrid).

Foliar application did early in the morning. Plant height, leaf area index (LAI), leaf dry weight and stem diameter, seed in row, row in ear, seed in ear, shoot dry weight, harvest index, fertilizer use efficiency and seed yield were measured. Harvest index was calculated average of seed weight divide to average of seed weight + shoot dry weight and fertilizer use efficiency was plant dry weight with using fertilizer, plant dry weight with using fertilizer divide to range of fertilizer for every plot and seed yield of 2.0 m² was average of full seed weight in area harvest (g.m⁻²). MSTATC and Excel were used to analyses data and draw graphs, respectively.

Result and Discussion
Analysis of variance revealed that use of different concentration and their application stage and interaction effect of them on plant height affected significantly at 1% level of probabilities (table 1). The highest and lowest height produced 202.5 and 141 cm in all of the stages at 3% NFAC and earing
at 7% NFAC, 7% NFAC were 43.61% more than 3% NFAC. Increased values of all of the stages with 3% NFAC were found to be 6.13% as compared with control but in 5% NFAC weren’t like it and the minimum treatment in control of control were all of the stages to be 16.49%. Foliar application with 7% NFAC decreased height in every method in compare with control treatment and the lowest height were bearing 22.24% in compare with control (Table 2).

Yield and quality variations of corn silage associated with different harvest heights, and the yield and quality contributions of various plant segments below the ear were determined over a 3-year period, at experiment and increase in harvest height from 15 to 90 cm from the soil level decreased forage yields from 13.7 to 11.2 m t ha⁻¹, while in vitro dry matter digestibility (IVDMD) increased from 45.1 to 51.1% [13]. All main effects, height, plant population and hybrid were significant for most yield and quality variable with no consistent interactions [11].

Analysis of variance revealed that N concentration and application stage diameter stem affected significantly at 1% level of probabilities (Table 1). N foliar application decreased diameter stem in different stage in compared with control. The maximum and minimum stem diameter was control stem in different stage in compared with control. The N percent in high leaf but it wasn’t effective in low leaf in soybean.

Analysis of variance revealed that use of different concentration and their application stage and interaction effect of them shoot dry weight affected significantly at 1% level of probabilities (Table 1).

The maximum and minimum dry weight produced by tasseling with 3% NFAC and earring with 7% NFAC 184.3 and 95.43 g, respectively and tasseling was 93.13% more than earring. Increased values of tasseling and all of stages with 3% NFAC were found to be 75% and 64.58% respectively, as compared with those of control and N foliar application decreased shoot dry weight also seed pasty with 7% NFAC, 46.33% were found more than control treatment (Table 2). The ability of a crop variety to absorb large amount of nutrients and convert them into plant biomass on highly enriched soils [1,14]. Extracts from high nutrient content plant biomass like that of tithomia could also offer advantage of making the nutrient available to plants faster than through other any known methods [3].

The green biomass of tithomia was previously recognized to be high in nutrients and effective as a nutrient source for maize [24].

Analysis of variance revealed that different concentration and their application methods and mutual effect of them on row in ear significantly at 1% level of probabilities (Table 1). The highest row in ear was 15.3 in beginning seed filling with 3% and 5% NFAC and seed pasty with 3% NFAC also the minimum row was 13.77 in all of the stages treatment with 3% NFAC that they were 11.11% more than all of the stages with 3% NFAC. Foliar application increased all of the treatments except all of the stages in %3 NFAC of beginning seed filling and tasseling with 7% NFAC were found to be 2.1, 2.1, 0.73 percent, respectively as compared with those of control (Table 2).

Analysis of variance revealed that nitrogen concentration leaf area affected significantly at 5% level of prohibitive (Table 1). The maximum and minimum leaf area produced by 3% and 7% NFAC (3414 and 1814 cm²) that 3% NFAC was 88.2% more than 7% NFAC. An increased value of 3% NFAC was found to be 15.8% as compared with 5% NFAC. Leaf area was 3008 cm² in using foliar application there for N foliar application increased leaf area that 3% NFAC was 13.49% more than earing. Increased values of all of the stages with 3% NFAC were found to be 2.1, 2.1, 0.73 percent, respectively as compared with those of control (Table 2).

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Analysis of variance revealed that different concentration and interaction effect of nitrogen application and application stage on seed in ear affected significantly at 1% level of probabilities (Table 1). The maximum and minimum seed in ear were 714.1 and 417.6 in all of the stages with 3% NFAC and 3% NFAC were found to be 16.5% and 13.07% as compared with those of control. N foliar application was found to be 6.64 and %3.8, respectively as compared with those of control treatment suitable period for partitioning and nitrogen harvest index increase significantly at %5 levels. Tasseling was 9.8% more than beginning seed filling. Brandau and Below [9] in their study showed that removing excessive or non-uniform corn residue from the seed row increased germination and emergence rate by improving seed depth uniformity and by increasing soil heat unit accumulation.

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Fig. 1: Nitrogen foliar application in corn growth stage effect on stem diameter

Fig. 2: Nitrogen foliar application concentration effect on corn stem diameter

Fig. 3: Nitrogen foliar application concentration effect on corn leaf area

Fig. 4: Nitrogen foliar application concentration in corn seed in row different growth stage effect on corn leaf area

Fig. 5: Nitrogen foliar application concentration in different growth stage effect on corn seed in ear

Fig. 6: Nitrogen foliar application concentration in different growth stage effect on corn seed in ear

Fig. 7: Nitrogen foliar application in corn growth stage effect on harvest index

Fig. 8: Nitrogen foliar application concentration in different growth stage effect on corn fertilizer use efficiency
Simulations revealed that a reduction in rates of increase of NHI between early and late stages of seed growth had little impact on the overall linear behavior of NHI increase for the entire period of seed-fill. The analysis also highlighted the importance of total plant N accumulation in influencing grain average value of 0.79 or -0.02 (p<0.05) [21].

Analysis of variance revealed that application stage and interaction effect of different concentration and their application methods in fertilizer use efficiency significantly at 1% level of probabilities (Table 1). Seed pasty with 3% and tasseling with 5% NFAC was 1.117, - 0.073 kg.kg⁻¹, respectively that seed pasty with 3% NFAC was high and tasseling with 5% NFAC was low in compared with all of the stages. Foliar application with 3% NFAC in compared with the other concentration was significant. The maximum fertilizer use efficiency with 5% were tasseling, beginning seed filling + tasseling, seed pasty treatments and with 7% NFAC were control, seed pasty and in all of the concentration seed pasty high (Figure 8). Effect of N fertilizer (60 kg N.ha⁻¹) on the efficiency of the sugar beet crop in late summer was the late N fertilizer dose increased the N concentration in the plants and canopy size in late summer [23]. Effect of varied N uptake and fertilizer N use efficiency of a six row barley was the highest yield N-treatments of six row regularly took up less N at EC 32 (95 kgN.ha⁻¹ on average) than the non optimally fertilized treatments [22]. The efficiency of nitrogen fertilizer for rice in Bangladeshi farmer’s fields was the application of large amounts of N fertilizer (39-175 kg N ha⁻¹) by farmers to increase yields of high yielding variety rice were not justified agronomically and ecologically [17].

Conclusions

Results obtained from this study indicate that N foliar application in different concentration had different affect on yield and different parts of yield of corn (704). Foliar application with 3% increased all of the parts in compared with control treatment but using of high concentration weren’t useful and sometimes they were low. Also N foliar application in different methods had different effect on parts of yield. The maximum height, leaf dry weight, diameter stem, seed-row, row in ear, seed in ear, shoot dry weight, harvest index, fertilizer using efficiency and seed yield were in all of the stages, tasseling + beginning of filling period, control, all of the stages, beginning of filling period, all of the stages, tasseling, tasseling, seed pasty, tasseling. On the base on experiment, N foliar application with 3% concentration in tasseling increased 62.1% yield of corn.

Table 1: Analysis of variance of surveyed attributes of corn

<table>
<thead>
<tr>
<th>S.O.V</th>
<th>df</th>
<th>height stem diameter</th>
<th>Leaf area</th>
<th>Leaf dry weight Shoot dry weight Seed row Seed in ear</th>
<th>Row in ear</th>
<th>yield</th>
<th>Harvest index</th>
<th>Fertilizer use efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rep</td>
<td>2</td>
<td>0.0311</td>
<td>166575.44</td>
<td>45.7317</td>
<td>63.83</td>
<td>0.76</td>
<td>84.183</td>
<td>0.118</td>
</tr>
<tr>
<td>FAC</td>
<td>2</td>
<td>0.871**</td>
<td>481272.73</td>
<td>10.1601</td>
<td>6276.05**</td>
<td>236.99</td>
<td>6230.141**</td>
<td>0.455**</td>
</tr>
<tr>
<td>Error 1</td>
<td>4</td>
<td>0.042</td>
<td>691523.23</td>
<td>8.994</td>
<td>90.1</td>
<td>2.1</td>
<td>465.23</td>
<td>0.058</td>
</tr>
<tr>
<td>FAS</td>
<td>5</td>
<td>0.103**</td>
<td>239157.75</td>
<td>36.882**</td>
<td>1033.54**</td>
<td>27.54*</td>
<td>3916.78</td>
<td>0.725**</td>
</tr>
<tr>
<td>FAC x FAS</td>
<td>10</td>
<td>0.5ns</td>
<td>139550.65</td>
<td>73.5311</td>
<td>1154.55**</td>
<td>53.5**</td>
<td>1082.328**</td>
<td>0.166**</td>
</tr>
<tr>
<td>Error 2</td>
<td>36</td>
<td>0.24</td>
<td>7314533.73</td>
<td>66.956</td>
<td>230.7</td>
<td>11.1</td>
<td>2486.379</td>
<td>0.199</td>
</tr>
<tr>
<td>CV%</td>
<td></td>
<td>3.78</td>
<td>6.87</td>
<td>41.161</td>
<td>8.49</td>
<td>11.94</td>
<td>7.43</td>
<td>7.93</td>
</tr>
</tbody>
</table>

|                  |        | 3.03                 | 7.34      | 5.68               | 17.66         |

ns, * and ** non significant, significant at 5% &1% respectively, FAC: foliar application concentration, FAS: foliar application stage

Table 2: Effect of nitrogen foliar application in different growth stages on corn attributes

<table>
<thead>
<tr>
<th>NFAC</th>
<th>Foliar application stage</th>
<th>Height (cm)</th>
<th>Leaf dry weight</th>
<th>Row in ear</th>
<th>Fertilizer use efficiency (kg.kg⁻1)</th>
<th>Shoot dry weight (g.plant⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3%</td>
<td>tasseling</td>
<td>159.4bcdef</td>
<td>34.8ab</td>
<td>14.61b</td>
<td>0.32bc</td>
<td>184.3a</td>
</tr>
<tr>
<td></td>
<td>earing</td>
<td>188.9a</td>
<td>34abc</td>
<td>14.65b</td>
<td>0.397bc</td>
<td>151.3b</td>
</tr>
<tr>
<td></td>
<td>beginning of seed filling</td>
<td>164.4bced</td>
<td>33.63abd</td>
<td>14.87ab</td>
<td>0.54b</td>
<td>137.5bcd</td>
</tr>
<tr>
<td></td>
<td>seed pasty</td>
<td>164.6bced</td>
<td>23.4h</td>
<td>15.3ab</td>
<td>-0.0733c</td>
<td>121cde</td>
</tr>
<tr>
<td></td>
<td>tasseling + seed filling</td>
<td>159.3bcdef</td>
<td>28dcedf</td>
<td>14.97bc</td>
<td>0.103bc</td>
<td>138.4bc</td>
</tr>
<tr>
<td></td>
<td>all of stages</td>
<td>190a</td>
<td>31.3abcdef</td>
<td>13.77d</td>
<td>0.333bc</td>
<td>173.3ab</td>
</tr>
<tr>
<td>5%</td>
<td>tasseling</td>
<td>155.2defg</td>
<td>26.2efgh</td>
<td>14.3bce</td>
<td>-0.0733c</td>
<td>121cde</td>
</tr>
<tr>
<td></td>
<td>earing</td>
<td>158.2bcdef</td>
<td>33.6abd</td>
<td>14.97c</td>
<td>0.4967bc</td>
<td>113.6cde</td>
</tr>
<tr>
<td></td>
<td>beginning of seed filling</td>
<td>170.9bcde</td>
<td>32.2abcde</td>
<td>15.3ab</td>
<td>0.0 bc</td>
<td>107.2de</td>
</tr>
<tr>
<td></td>
<td>seed pasty</td>
<td>162bced</td>
<td>25.4fgh</td>
<td>14bce</td>
<td>0.2176bc</td>
<td>126.1cde</td>
</tr>
<tr>
<td></td>
<td>tasseling + seed filling</td>
<td>155.2cdefg</td>
<td>37.5a</td>
<td>14.4bcde</td>
<td>0.3967bc</td>
<td>130.4cde</td>
</tr>
<tr>
<td></td>
<td>all of stages</td>
<td>149.5efg</td>
<td>32.2abcde</td>
<td>14.67c</td>
<td>-0.05c</td>
<td>118.2cde</td>
</tr>
<tr>
<td>7%</td>
<td>tasseling</td>
<td>165.9bcde</td>
<td>30.7abcdefg</td>
<td>15.1abc</td>
<td>0.37bc</td>
<td>108cde</td>
</tr>
<tr>
<td></td>
<td>earing</td>
<td>151.6defg</td>
<td>27.1ddefgh</td>
<td>14.4bcde</td>
<td>-0.0633c</td>
<td>95.4cde</td>
</tr>
<tr>
<td></td>
<td>beginning of seed filling</td>
<td>169.3c</td>
<td>25.67efgh</td>
<td>14.6bcde</td>
<td>-0.0267bc</td>
<td>101.4cde</td>
</tr>
<tr>
<td></td>
<td>seed pasty</td>
<td>144.2fg</td>
<td>35.47ab</td>
<td>15.03bc</td>
<td>0.081bc</td>
<td>126cde</td>
</tr>
<tr>
<td></td>
<td>tasseling + seed filling</td>
<td>152.3defg</td>
<td>24.69</td>
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<td>113.6cde</td>
</tr>
<tr>
<td></td>
<td>all of stages</td>
<td>179.03ab</td>
<td>33.53abcd</td>
<td>14.99bc</td>
<td>0.0bc</td>
<td>113.2cde</td>
</tr>
</tbody>
</table>

Control
References


