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The investigation of growth reducer Cycocel effect on yield and some quantitative characteristics of rice (oryza sativa) at different nitrogen levels

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ABSTRACT: Lodging at the maturity is one of the native cultivars cultivation problems in Guilan province. Using growth reducer such as Cycocel to increase the tolerance to lodging is a strategy permits more application of nitrogen to receive higher yield. Therefore an experiment was conducted in 2012 as split plot in complete randomized blocks design with 3 replications in Rasht (north of Iran). Nitrogen manure of Urea source with was 3 levels (0, 150 and 300 $kg.ha^{-1}$) as main factor growth reducer Cycocel with 0, 1500 and 3000 ppm concentrations was considered as sub factor. Variance analysis results for treatment combinations as well as various concentrations of Cycocel indicated significant difference (0.01) for all the studied characteristics. Comparing the mean of the treatments interaction also indicated that native cultivar, Hashemy, has achieved 4.77 ton. Ha^{-1} yield by using 300 kg/ h nitrogen and 1500 ppm Cyclocel spraying.

***Keywords*:** Rice, Cycocel, Growth reducer, Yield, Nitrogen

INTRODUCTION

Rice as one of most important cereals worldwide is considered as the major food of more than 2 bilions of people acroos the world (Akhgary, 2004; khajeh pour, 2004). Rice growing lands area in Iran is 600000 ha and it provides the 13% of calories required for *BMR*. Nitrogen is one of necessary elements for initial growth of plant and plays role in formation of enzymes, metabolic compounds and DNA structure (Akhgary, 2004). Rice alike any other crop requires nitrogen for its growth and development (Salar dini, 1992).The role of nitrogen as a key factor to attain optimum yield of rice is undeniable. High yield of rice achieve by supplying the adequate amount of nitrogen. (Shi et al., 1994) stated that rice cultivars, with higher amount of nitrogen at grain filling stage, Had higher potential for yield. (Ivazaky et al., 1993) using marked nitrogen indicated that nitrogen contributes as the major source to fill the higher surrounded grains of the ear, leading to early maturity of the ear. According to the fact that plant growth and development and its yield depends on photosynthetic process and nitrogen may influence directly on photosynthesis rate, its deficit may decrease the absorption of carbon dioxide. One of the problems of native cultivars cultivation in Guilan province is lodging or reducing in maturity. Despite the high yield of rice, grain yield in the fields confronted to lodging conditions will decrease up to 75% due to stem lodging and severe shedding of grain at the time of maturity (Khodabandeh, 2001). Despite the simple inheritance of plant height in rice, development of tolerance to lodging is complicated and requires the simultaneous in heritance of characteristics such as thickness of stem and short lengthed internodes of lower stem (Emam et al., 2003). Adjustment of plant growth and development using growth reducers such as Cycocel to reduce the plant height and increase the tolerance to lodging is a technique permitting the greater amount of nitrogen to attain higher yield (Mohaghegh et al., 2007). Most common utilized aniumic compounds are Cycocel and mpiquate chloride. These compound

prevent the cyclic conversion of geranial pyrophosphate to copayol prophosphate and gradually they will be inhibitors of gibrelin. Plants treated by anium compounds have short internodes, darker thick leaves compared to untreated controls (Ilikaei et al., 2003). When plant growth is prevented by anium compounds, other benefits are achieved. There are reports indicating that aniom compounds can increase the pure photosynthesis (Ilikaei et al., 2003). A major applying of plant growth reducers in agriculture is controlling the lodging of grain cereals like wheat, rice, rye and barley. At present between growth reducers, Cycocel has the greatest consumption rate (Doberman et al., 2002). Cycocel (CCC) is between most wide spread growth reducer of plants particularly in Europe and recently is utilizing greatly to decrease the lodging and to control the crop growth (Emam et al., 2003). The Effect of CCC on various plants as well as cultivars of a species varies. plant species show different responses to this compound (Emam et al., 2003). Lodging is decrease by using of Cycocel, harvesting will facilitate and yield loss will be decrease (Mohsen zadeh et al., 2003). Cycocel treatment decreases the cell size and increases the cell wall thickness, thickness the all sap, increases the number of stem sets, decreases the length of internodes and increases the stem diameter. In addition, above mentioned properties increase the ability to use nitrogen manures in cereals (Mohsen zadeh et al., 2003). (Singh et al., 2002), stated that using Cycocel decreases the plant height up to 23% and significantly increases the grain yield. Given the fact that using nitrogen in the rice may increase the stem height. growth reducer Cycocel can decrease the plant height by decreasing the internode height (Mohsen zadeh et al., 2003). Generally the objectives of this experiment were study of the interaction of the growth reducer, CCC, and different nitrogen levels effects on yield of native rice, Hashemy and determination of the best nitrogen level and the best concentration of Cycocel to increase the yield of native rice, Hashemy.

MATERIALS AND METHODS

Present study was performed as split plot using complete randomized blocks basic design in 3 replications in research field of Rasht agricultural- meteorology center in Guilan province in 2011 with 49°38′ E longitude and 37°12′ N latitude in a plot with 600 m^2 area. Annual precipitation rate in experiment area based on 10 years mean is 1637.9 mm and its annual air temperature is 15.7°C. According to meteorological divisions, this region is considered as warn semi- Mediterranean regions with warn summers and moderate winters.

Soil pH was 6.93 and soil texture was clay loamy. Major test factors were including nitrogen manure of urea source with 3 concentrations (0,150,300 $kg.ha^{-1}$) and minor factor was including growth reducer Cycocel (CCC) in 3 concentrations (0,1500,300 $ppm.ha^{-1}$). At the time of preparing the major plot, based on soil test results, nitrogen treatment of urea source was applied evenly based on test objectives as 150 and 300 $kg.ha^{-1}$, 3 times. In addition , potassium basic manures of potassium sulfate source equal to 300 $kg.ha^{-1}$ and phosphor from triple super phosphate equal to 25 $kg.ha^{-1}$ it was mixed to field soil before transplanting then lots were made even using troweling. Transplanting was performed with 20×20 plantation, 3 seedlings were planted by labor in each heap. Growth reducer (CCC) was sprayed evenly in stage C of rice growth (25 to 35 days after planting the rice) in early hours of morning using handy sprayer with 3 times pressure and 400 $lit.ha^{-1}$ spraying volume. Grain yield, the number of healthy grain in the ear, the number of hollow grain in the ear, the number of fertile tiller and weight of 1000 grains were measured. To define the grain yield (paddy) with removing the marginal effect, 1 m^2 area of each plots center was taken measured with 13% moisture. Data obtained from experiment was analyzed using SAS software. Means were compared using Duncan multiple rang test (0.05).

RESULTS AND DISCUSSION

1000 grains weight

Variance analysis results for property of 1000 grains weight indicated that there was significant difference between various levels of Urea manure and there was very significant difference for various concentrations of Cycocel as well as interaction between Urea manure and Cycocel (table 1). Studies of mean comparing indicated that maximum weight of 1000 grains 25.12(g) has been achieved by not using Urea manure and not spraying the Cycocel, which didn't indicate significant difference compared to treatment compound (not using Urea manure and spraying with 1500 ppm Cycocel) as well as treatment compound (using 300 kg/ha Urea manure and spraying 1500 pmm Cycocel) (table 2). The least weight of 1000 grains (23.49 g) was achieved by not spraying with Cycocel and using 300 kh/ha Urea manure (table 2-fig 1). It seems that treatment compounds didn't affect on the weight of 1000 grains. The weight of 1000 grains depends on carbon hydrate rate reserved in initiation of grain filling and plant genotype. Cultivar affects on increased weight of 1000 grains, Maximum weight of each grain is among the properties dependant on plant genotype.

(Khaje et al., 2008) also in his own study on wheat cultivars concluded that Cycocel treatment on wheat cultivars didn't show significant difference in respect of weight of 1000 grains. From results of present study, it is concluded that the weight of 1000 grains is influenced by the cultivar and genotype of the plant and utilized treatment compounds and inputs didn't affect on its increase or decrease. Generally it is obvious that the weight of 1000 grains is among stable components of grain yield in rice plant and in lower rate is influenced by environmental factors (Aspinall et al., 1964; Begg et al., 1976; Emam et al., 1996).

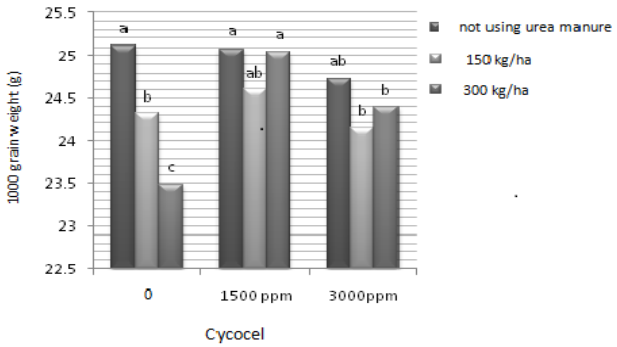

Figure 1. comparing the mean interaction of Urea manure and Cycocel for 1000 grain weight

Number of fertile tiller

Variance analysis results for the number of fertile tiller, indicated that there is no significant difference between various rates of Urea manure but there is very Significant difference between interaction of Urea manure and Cycocel (table 1). Comparing the mean treatment interaction showed that spraying by 1500ppm Cycocel and applying 150kg.ha^{-1} Urea manure increased the number of fertile tiller to 12.10 tiller per plant (table 2). Minimum number of fertile tiller was achieved with 9.76 fertile tiller per plant by not utilizing Urea manure and spraying 3000ppm Cycocel (table 2- Figure 2). Researchers stated that growth reducer Cycocel spraying treatment increased the cytokine hormone transfer from root to the area producing the branch shoot in the plant. This way it will increase the length if development period of branch forming shoots (Mohaghegh et al., 2007) and may increase the number of branches in the plant. According to (ilikaey and Emam ,2003), Cycocel treatment insignificantly increased the number of branches in each plant with 70 plant.m^{-2} density.

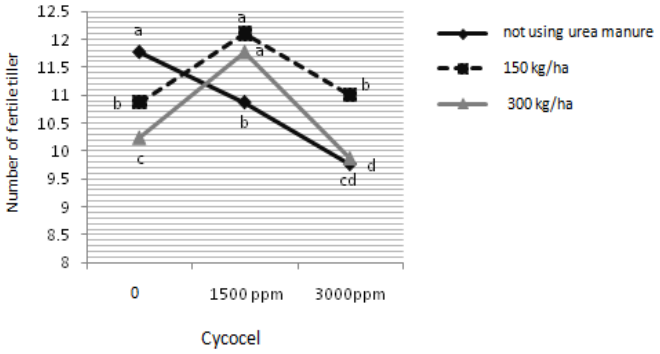

Figure 2. comparing the mean interaction of Urea manure and Cycocel for number of fertile tillers

Number of healthy grain in ear

Variance analysis for the number of healthy grains in the ear, indicated that there was very significant difference between various concentrations of Urea manure, various concentrations of Cycocel as well as interaction of Urea manure, and Cycocel (table1). Comparing the mean interaction of Urea manure × various Concentrations of Cycocel indicated that the more is Urea manure application and spraying with more concentration of Cycocel, the more will be the number of healthy grains per ear. So that with decreased spraying of Cycocel and consumption of Urea manure, Number of healthy grains in the eare will decrease. Results indicated that the maximum number of healthy grain is up to 124.83 grains.ear^{-1} which was achieved by using 300kg Urea

manure.ha^{-1} by spraying 3000ppm Cycocel concentration and minimum number of healthy grains up to 103.37 grains.ear^{-1} was achieved by using 150kg.ha^{-1} Urea manure and 1500ppm Cycocel spraying (table 2- Figure 3). Stem is considered as an important source of carbon hydrates in the plant. It may play an important role in grain filling to supply the phloem sap to hill the grain (Khajeh et al., 2008). It seems that plants treated with Cycocel were associated to change of plants and tillers angle, thus improving the light penetration to the canopy. Before flowering sink size was increased and after flowering, due to positive feedback effect of increased sink size on plants photosynthesis rate, phloem sap rate produced to fill the additional grains were increased (Ma et al., 1992; Waddington et al., 1988). (Miran zade. et al., 2011) also in a study on wheat cultivars and treatment combination of nitrogen and Cyclocel concluded that applying 80 kg.ha^{-1} nitrogen and spraying with Cyclocel increased the yield and radiation use efficiency. In addition studies indicated that Cyclocel treatment has increased the number of grain per plant (Hay et al., 1989).

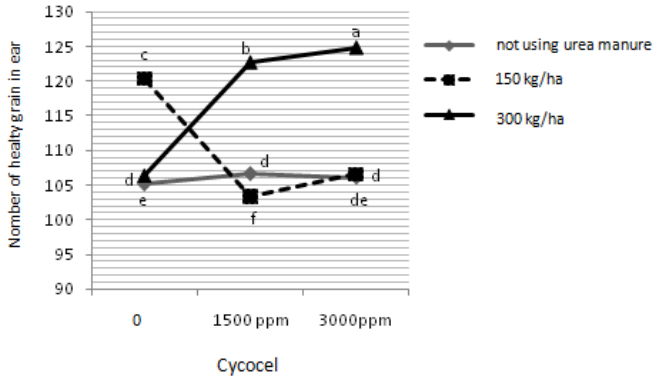

Figure 3. comparing the mean interaction of Urea manure and Cycocel for healthy grains Number in ear

Number of Hollow grains in ear

Variance analysis results for the number of hollow grain in the ear indicated that there was significant difference between different levels of Urea manure and there was very significant difference for various concentrations of Cycocel as well as interaction of Urea manure and Cycocel (table1). Study on results of mean comparison indicated that minimum number of hollow grain per the ear equal to 3.5 grain.ear^{-1} was achieved by not using Urea manure and spraying 1500ppm Cycocel (Table 2- Figure 4).

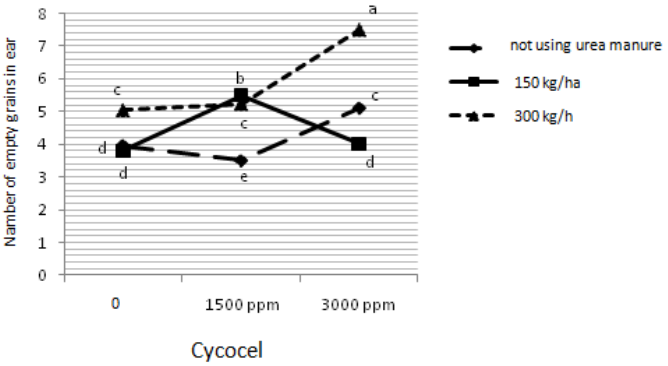

Figure 4. comparing the mean interaction of Urea manure and Cycocel for hollow grains Number in ear

Grain yield

Results of variance analysis for grain yield indicated that there was very significant difference between various levels in Urea manure, various concentrations of Cycocel as well as interaction between Urea manure and Cycocel (table 1). In addition comparison of the mean treatment interaction indicated that native culticar, Hashemy, has achieved maximum yield rate of 4.77 ton.ha^{-1} using 300 kg.ha^{-1} Urea manure and spraying 1500 ppm Cycocel. While minimum yield rate with 2.55 ton.ha^{-1} was achieved with not using Urea manure manure and not spraying Cycocel (table 2- fig 5). Grain yield is the most important property in grain crops and reaction of genotype in various

envoronments may vary. As it was mentioned, using of Cycocel in comparison with not using Cycocel, prasented higher yield of grain (table 2). One reason for this can be the increase of number of fertile tiller and causes the increasing number of grain in ear in per unit area. in one hand, based on plant's self adjasment and optimized dedication of phloem sap, more dedication is done on grains and this causes more yield. in the other hand decrease of plant height can cause decrease in plant's resistance against factors like lodging and plant's reducing which it self causes the decrease of yield (Mohaghegh et al., 2007) This occurs while overconsumption of nitrogen manure is necessary for producing dry matter and variety characteristics must lack vegetative growth until phloem sap which reaches to ear gets increased.

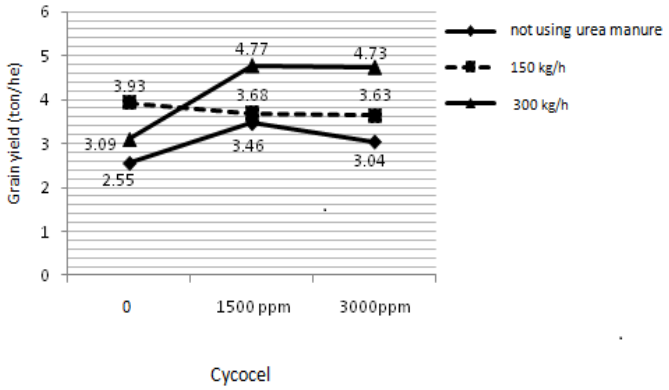

Figure 5. comparing the mean interaction of Urea manure and Cycocel for Grain yeild

Table 1. variance analysis table. S.O.V, df, GY, NFT, 1000 GW, HN, EN is source of variation, degree of freedom, grain yield, number of fertile tillers, 1000 grain weight, healthy grains Number in ear and hollow grain number in ear respectively

Mean squares						
S.O.V	df	GY	NFT	11000 GW	HGN	HOGN
R	2	0.009	0.003	0.32	0.003	0.012
N	2	3.18**	1.19ns	1.23*	75.1**	5.37*
E_1	4	0.08	0.21	0.13	0.57	0.4
C	2	1.5**	4.21**	1.01**	9.14**	3.02**
N× C	4	0.97**	1.61**	0.59**	42.79**	1.82**
E2	12	0.059	0.053	0.1	0.31	0.32

ns,*,**, is non significant, significant differences in 0.05 and 0.01 probability respectively

Table 2. comparing the mean of interaction of Urea manure and Cycocel for grain yield (GY), number of fertile tillers (NFT), 1000 grain weight (1000 GW), healthy grains Number in ear (HGN) and hollow grain number in ear (HOGN) in native culticar Hashemy by Duncken test (0.05)

Trearitmant	GY (ton/he)	NFT	1000GW (g)	HN	OGN
N1c1	2.55e	11.77a	25.12a	105.21e	3.97c
N1c2	3.46cd	10.87b	25.08a	106.63d	3.500c
N1c3	3.04d	9.76d	24.73ab	106.12de	5.32b
N2c1	3.93b	10.87b	24.3b	120.28c	4.25bc
N2c2	3.68bc	12.10a	24.68ab	103.37f	5.21b
N2c3	3.63bc	11b	24.15b	106.55d	4.36bc
N3c1	3.09d	10.23c	23.49c	106.42d	5.21b
N3c2	4.77a	11.77a	25.04a	122.71b	5.1b
N3c3	4.73a	9.86cd	24.39b	124.83a	6.92a

n1, n2 andn3=0, 150 and 300 kg/ha^1 Urea manure, respectively
c1, c2 and c3=0, 1500 and 3000 ppm/h Cycocel, respectively

CONCLUSION

The results of this experiment shows positive reaction of native cultivar Hashemy applying 300kg.ha^{-1} of Urae manure in the presence of Cycocel (table 2). This charactrristic does not only relate to dry matter production but also relates to more functional ability.Increase of yield depends on use of Nitrogen which influences number of panicles more than their measure (Dedatta et al., 2003) The result of this research show that using different

concentration of Cycocel and interaction of Cycocel and Urea have more influence in yield and every part of yield and also causes their increase (table 2).

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