

N-Fertilizer Apply as Top Dressing in Barley Yield and Seed Protein

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Abstract

The effect of N-fertilizer top dressing on yield and seed protein in barley was carried out at Mae Hae Research and Training Station, Faculty of Agriculture, Chiang Mai University. Five rates of nitrogen fertilizer 0, 5, 10, 15 and 20 kgN/rai, were applied as top dress to BRW.9 variety planted with basal application of 15-15-15 fertilizer at 25 kg/rai in RCBD with 4 replications. The results indicated that increasing rate of nitrogen top dressing caused nitrogen content in barley seed to increase significantly with linear regression equation $Y = 2.0488 + 0.01002X$ and $r^2 = 0.97$ and the percentages of crude protein determined by Kjeldahl method were 12.18, 12.42, 12.85, 12.95 and 13.38 respectively, but there was no change on protein content when determined directly by protein solubility, and the percentages of crude protein obtained by direct method were 10.79, 11.03, 11.26, 10.99 and 11.09 respectively. Differences in the percentages of crude protein from both procedures could be explained that the higher crude protein content obtained from Kjeldahl method was non protein organic nitrogen that was not measurable by direct method. The number of seed per ear was 14.4 at the rate of 10 kgN top dressing which was significantly higher than 13.6, 12.8 and 13.5 at 0, 15 and 20 kgN respectively. There were no responses of every rate of nitrogen top dressing fertilizer on number of ear per area, 1000 seed and yield.

Introduction

Nitrogen fertilizer is essential element for crop growth and yield of barley. It affects on increasing total nitrogen content and protein content in barley seeds which is not suitable for malting by increasing time of a germination (Hunter, 1962; Bathgate, 1987). Optimum quantities of total nitrogen found range from 1.2 to 1.75 % by Kjeldahl method where that converted to quantities of protein by using conversion factor 6.25 (Zubriski, 1970 ; Varvel and Severson, 1987 ; Bulman and Smith, 1993). Rutjanakraikarn and Rattanapanon (1988) recommended conversion factor 5.83 for Thailand. Protein quantities divided by soluble property in 4 groups (Osborne, 1924) as: Albumin, Globulin, Prolamin and Glutelin. Kjeldahl method can not indicate the different groups according to their soluble property.

The objective of this study were to analyze the effect of nitrogen fertilizer as top dressing on total nitrogen, protein quantities divided by soluble property, yield and yield components. To find out the group of protein which has main affect on malting quality.

Materials and methods

Barley seeds were planted at Mae Hae Research and Training Center, faculty of Agriculture, Chiang Mai University, Thailand. Soil fertility was determined before sowing. Subplot size was 7m x 22m, spacing between rows were 25cm. with seed rate 20 Kg/Rai and the fertilizer

rate was 25Kg/Rai broadcasted as 15-15-15 formula. The harvesting was done after 75 days of germination. Randomized Complete Block Design was followed with 4 replications. Top dressing of nitrogen fertilizer was used 5 rates as:

T1 = Non top dressing nitrogen

T2 = 5 KgN/Rai

T3 = 10 KgN/Rai

T4 = 15 KgN/Rai

T5 = 20 KgN/Rai

Seed sampling and tests were done as follows:

Determination of total nitrogen and protein in seeds

It was done by Kjeldahl method for nitrogen estimation and conversion factor 5.83 was used to estimate total protein.

Quantities of protein separated on the basis of their soluble properties

It was done by modified method of Singh et al. (1980) and Markwell et al. (1978).

Yield component of barley seed

seed per ear, ear per area, 1000 seeds weight and yield per rai. (1 ha = 6.25 rai)

Results and Discussion

Table 1 shows that barley seeds response on total nitrogen content by 2.29% and crude protein content by 13.38% when nitrogen fertilizer was applied as top dressing at the rate of 20 kg/rai. And it was also found that total nitrogen content of barley seeds responses to top dressing of nitrogen had relations in linear model which equations is as: $Y=2.0488+0.01002X$ and $r^2=0.97$.

Table 1: Effects of nitrogen fertilizer applied as top dressing on total nitrogen content (%) and crude protein content (%) of barley seed

Top dressing nitrogen (Kg/rai)	Total nitrogen content (%)	Crude protein content (%)
0	2.09 d	12.18 d
5	2.13 cd	12.42 cd
10	2.20 bc	12.85 bc
15	2.22 b	12.95 b
20	2.29 a	13.38 a
F-test < 0.05	*	*
LSD 0.05	0.077	0.457
CV	2.29	2.29

When protein contents were separated as Globulin, Glutelin, Albumin and Prolamin on the basis of their soluble properties, the Globulin content was found highest, after that Glutelin then Albumin and the lowest content was Porlamin. Quantities of soluble proteins did not show any significant response to top dressing of nitrogen fertilizer.

Yield component of barley seeds has been responded significantly by top dressing of nitrogen resulted as highest seed per ear when added 10 kilogram per rai. But on ear per square meter, 1000 seed weight and yield per rai did not have significant response. For yield per rai responded to top dressing of nitrogen in relation to linear model, which equation: $Y=250.65-2.56X$ and $r^2=0.99$, that agrees with Zubriski (1970), Carreck and Christian (1991); While protein quantities in barley seeds determined by Markwell *et. Al.* (1978) had no response to amount of nitrogen fertilizer.

The results between protein quantities determined by using conversion factor by Kjeldahl method and determined from soluble protein are different. From this result, It is showed that protein quantities might be genetically controlled. If we increase nitrogen fertilizer, some parts convert in to protein, but some parts remain as accumulated in non protein and organic nitrogen (Harold *et al.*, 1981), because, when it increase up to maximum limit. This result showed that determination of protein quantities by using amount of nitrogen multiplied by conversion factor must be set with maximum total nitrogen content when it is needed.

Conclusion

Application of nitrogen fertilizer at the rate of 10 Kg/Rai as top dressing increases seed per ear more than 0, 15 and 20 Kg/Rai and other rate of fertilizer has no effect on ear per square meter, 1000 seed weight and yield per rai. Top dressing of fertilizer has effect to increase total nitrogen content in barley seeds. Conversion factor can be use under genetic limiting factor. Increasing nitrogen fertilizer has no effect on protein quantities when separated by soluble properties.

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Tables 2: Effect of top dressing of nitrogen fertilizer on total protein and on protein groups of barley seed.

Top dressing of nitrogen fertilizer (Kg/rai)	Protein content (separated on the basis of their soluble properties): (mg/gram)				Total protein Content (mg/gram)
	Albumin	Globulin	Glutelin	Prolamin	
0	21.13	38.63	31.50	16.65	107.9
5	21.92	40.80	30.60	17.00	110.3
10	21.90	41.55	31.73	17.45	112.6
15	22.27	39.97	30.15	17.52	109.9
20	22.70	39.98	31.27	17.00	110.9
F-test < 0.05	NS	NS	NS	NS	NS
LSD 0.05	-	-	-	-	-
CV	5.96	5.00	4.73	3.86	2.88

Tables 3: Yield components due to various rates of fertilizer as top dressing

Top Dressing Nitrogen (Kg/rai)	seed/ear	Ear/m ²	1000 seeds weight (gram)	Yield/rai
0	13.6 b	426	45.59	199
5	14.0 ab	488	45.84	228
10	14.4 a	354	46.69	217
15	12.8 c	388	45.52	202
20	13.5 bc	407	45.53	190
F-test 0.05	*	NS	NS	NS
LSD 0.05	0.71	-	-	-
CV	3.39	18.58	4.27	13.56