EVALUATION OF QUALITY PROTEIN MAIZE FOR FOOD AND NUTRITIONAL SECURITY IN THE WESTERN HILLS OF NEPAL

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INTRODUCTION

Maize (*Zea mays* L.) is the second major crop of Nepal and ranks first in the hills in terms of area, production, productivity and consumption. Its area, production and productivity are 928761 ha, 2283222 mt and 2.46 t/h respectivelly (MOAD, 2014). Apart from human consumption, it is the major constituent of cattle and poultry feed. It covers 20% of the world calorie supplient whilearound 85% of the maize production is used as food or feed (Olakojo, 2001). It is important for food security as well as feed. Moreover, the most vulnerable population of Nepal in terms of nutrition resides in the hilly region. Protein deficiency is the major reason for the malnutrition where animal food is also very less consumed (Krivanek *et.al,* 2007). The discovery of Opaque-2 (O2) and floury-2 (F2) mutant have opened tremendous possibilities for improvement of protein quality of maize which later led to the development of "Quality Protein Maize (QPM) (Gibbon and Larkin, 2005). QPM which is nutritionally superior over the normal maize is the new dynamics to signify its importance not only for food and nutritional security but also for quality feed for poultry, piggery and animal sectors as well. Quality Protein Maize has specific features of having balanced amount of amino acids with high content of lysine and tryptophan and low leucine & isoleucine. The balanced proportion of all these essential amino acid in QPM doubled the biological value of protein (80%) than that of normal maize (<50%) which is very close to the biological value of milk protein (90%) (Nuss and Tanumihardjo, 2011). Furthermore, maize is the main food crop in mid and high hills of Nepal where nutritionally vulnerable population inhabits. Hence the importance of quality protein maize (QPM) is higher in that region. In Nepal, conventional maize is used directly for human consumption as well as infant nutrition in the form of porridge during weaning period without any protein supplement such as egg, meat or beans, which are comparatively expensive especially for poor-resource in the rural areas. In this regards, the researches on QPM is continued by NARC and the trials are been conducted each year in many stations.

OBJECTIVES

To identify superior QPM genotype to enhance food and nutritional security of the hill farmers.

MATERIALS & METHODS

Seven Quality protein maize genotypes were planted in RCBD in the research block of RARS, Lumle in the year 2012 and 2013. Two rows of boarder was planted around the plot to reduce the experimental error. The individual plot size was 2 X 3 square meters with the spacing maintained at 75 by 25 cm2. Fertilizers were applied at 60:60:30 kg NPK and 20 tons of FYM per hectare at the time of sowing. Hand weeding followed by hoeing was done at 30 and 60 DAS and 30 kg Nitrogen per hectare was applied at the time of hoeing. Plants were harvested at the time of 100 % maturity.

Data recorded were days to 50 % tasseling, days to 50 % silking, plant and ear height, yield per plot and moisture content. The yield was taken from the middle two rows and finally it was converted to yield per hectare using the following formula:

$$\text{Grain yield (kg/h)} = \frac{(\text{Fresh weight}\times 10000)\times(100-\text{Moisture content})\times 0.8}{4.5\times 85}$$

Where, 4.5 is the net harvest area and 85 is deduced to convert the moisture level at 15 per cent. 0.8 is the shelling percentage of maize.

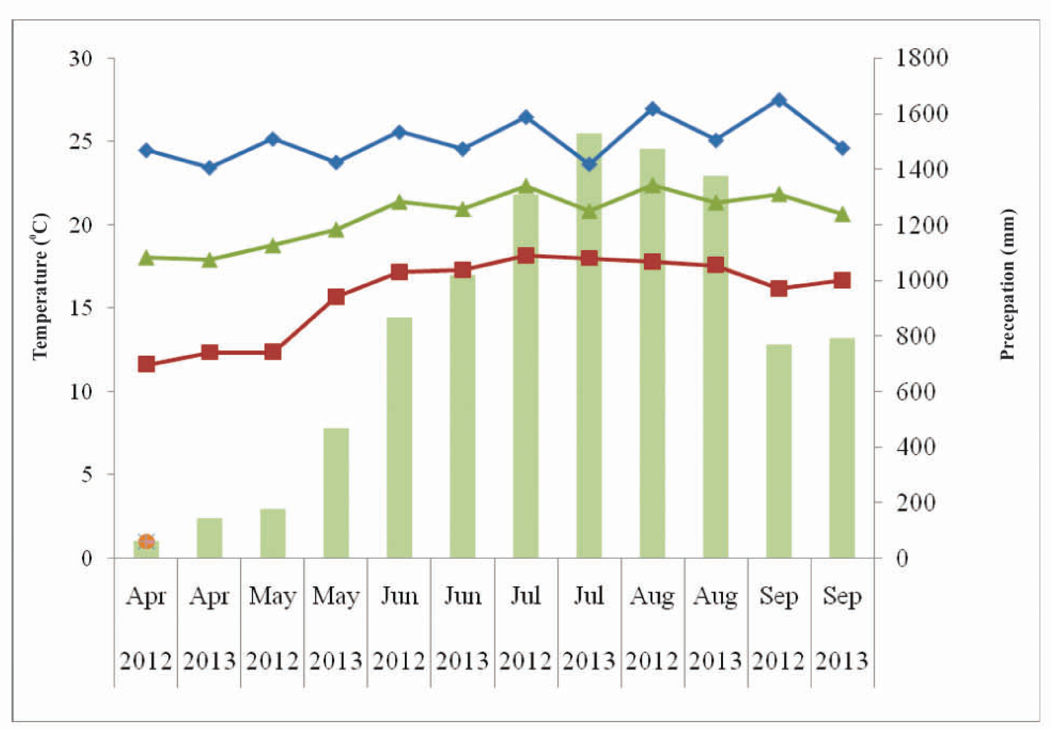
The obtained data was entered in Microsoft excel spreadsheet and was analyzed using MSTAT-C software.

The temperature was obtained from the daily data recorded and compiled in Regional Agricultural Research Station, Lumle.

MATERIALS & METHODS

The climatic pattern in the two years is presented in the figure 1. The maximum temperature was lower in the year 2013 of the same month in all the maize growing period. The mean monthly temperature went on increasing until May 2013. The mean temperature was lesser than that in 2012. Similar pattern remained in all the months afterwords until September. Th precipitation was more in 2013 than in 2012 except in the month of august which has no effect in the plant growth and development since it was the grain filling duration of the crop.

Figure 1. Comparison of monthly average temperature and the precipitation in the maize growing year in the year 2012 and 2013.



As we go through the genotypic value for the phonological triats, there was a highly significant difference among the genotypes for both days to male (Tasseling) and female (Silking) flowering (Table 1). Genotypes took on an average two days more to tassel and silk in 2013 as compared to 2012. This is because of the temperature in the two years as in Figure 1. This is in compliance with FAO (2013). Manakamana-5, which is a full-season normal maize, was earlier to tassel (70 DAS) followed by S01SIWQ-2 (72 DAS), S00TLYQ-B and Poshilo Makai-1 (74 DAS). Similarly, Manakamana-5 was earlier to silk (72 DAS) followed by S01SIWQ-2 (76 DAS), S00TLYQ-B and Poshilo Makai-1 (78 DAS).

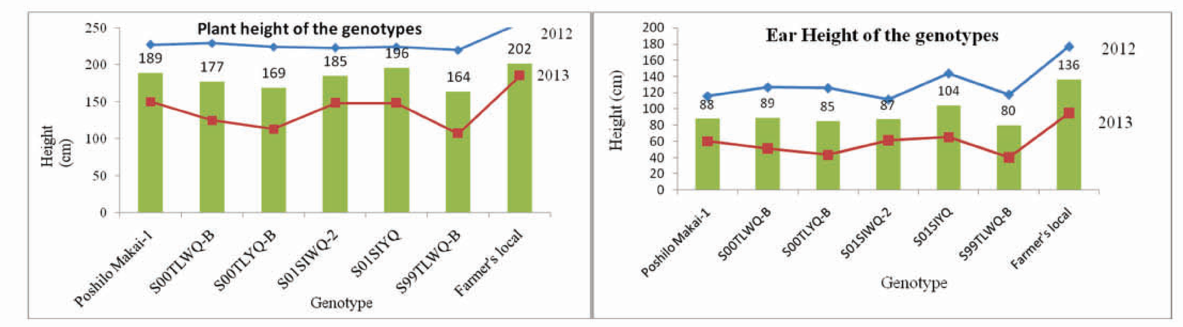
Table 1. Phenological triats of QPM genotypes in 2012 and 13 in Regional Agriculture Research Station, Lumle (1750 masl)

Genotype	Days to tasseling (days)			Days to Silking (Days)		
	2012	2013	Mean	2012	2013	Mean
Poshilo Makai-1 (Std. Check)	73	76	74	76	80	78
S00TLWQ-B	75	77	76	77	82	79
S00TLYQ-B	74	74	74	76	81	78
S01SIWQ-2	71	73	72	74	77	76
S01SIYQ	74	80	77	77	84	81
S99TLWQ-B	73	78	75	76	81	78
Manakamana-5 (Local check)	69	71	70	72	74	72
Grand mean	73	75	74	75	80	78
F Value			**			**
CV %			3.05			2.44
LSD (0.05)			0.92			0.77

Where, ** is significant at 1 per cent level of significance, CV is coefficient of variance, LSD is least significant difference and Std. is standard.

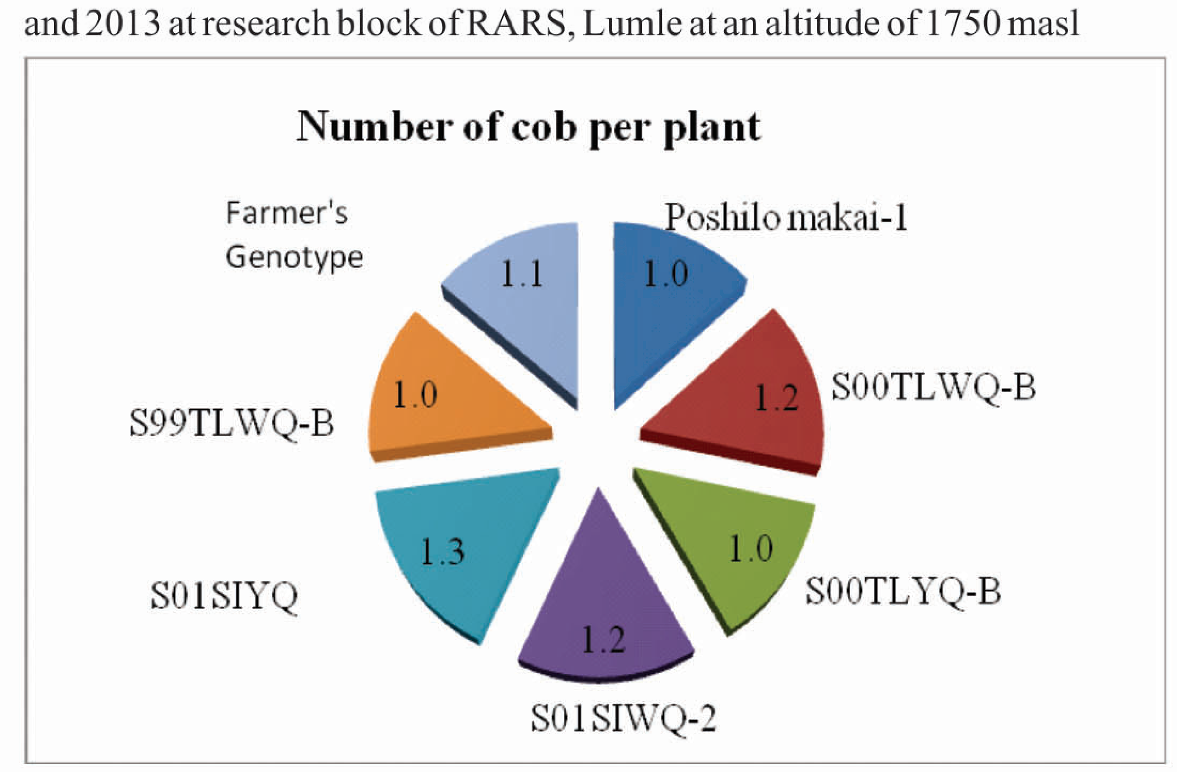
The plant and ear height differed highly in both the years and among the genotypes (Figure 2). Genotype S99TLWQ-B was the most dwarf genotype (164 cm) followed by S00TLYQ-B (169 cm) and S00TLWQ-B (177cm). Similarly, S99TLWQ-B had shortest ear placement position (80 cm) from the ground level followed by S00TLQ-B (85 cm) and S01SIYB-B (87 cm). The plant and ear height trait is associated with the lodging of plants which is very important in production point of view since whole yield loss is observed sometimes due to the lodging. Also, the plant and ear placement height are affected by soil moisture content as the growth and development process is directly related to soil moisture and absorption of nutrients in aquous solution by the roots.

Figure 2. Plant height and ear height of the genotypes under study at RARS, Lumle in the year 2012 and 2013 at an altitude of 1750 masl



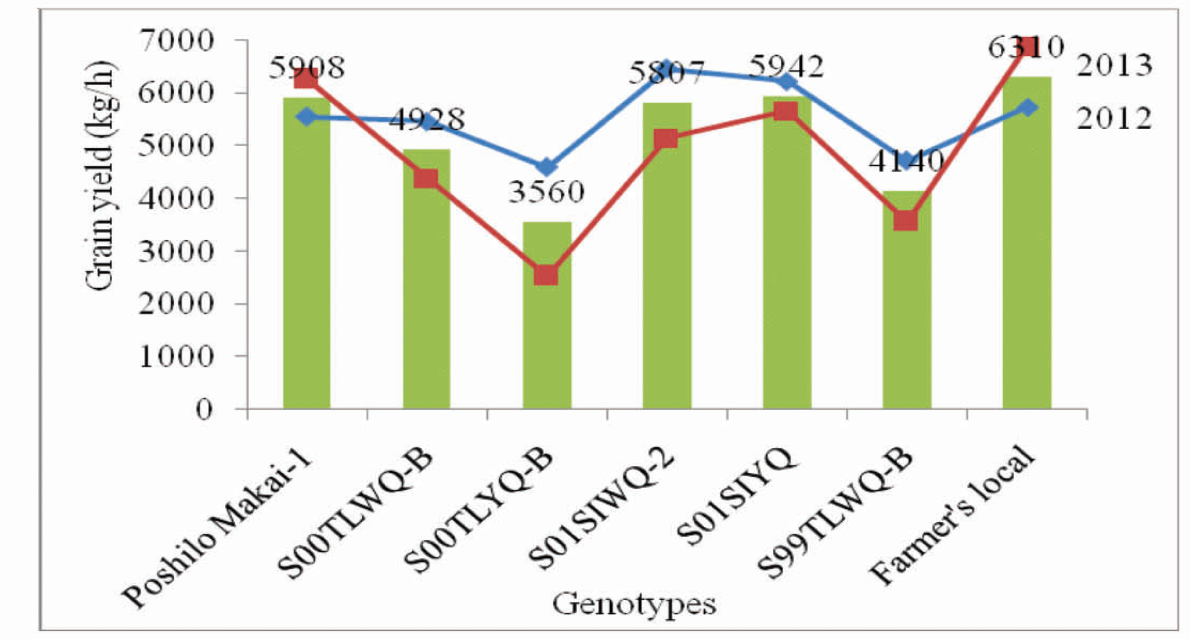
Number of cobs per plant is an index to determmine the genotypes ability to transfer more photosynthase to the grain and hence more production. Among the genotypes under study, S01SIYQ produced maximum double cobs per unit area (Figure 3) and hence is found better (1.3 cobs per plant) followed by S01SIWQ-2 and S00TLWQ-B (1.2 cobs per plant).

Figure 3. Number of cobs per plant in the QPM genotypes in the year 2012 and 2013 at research block of RARS, Lumle at an altitude of 1750 masl



Grain yield is the main parameter that any crop development program focuses to incorporate. The farmers, alternative consumers of the produce consumption also seek for the enhanced yield performance to adopt them. The genotypes were statistically different in the grain yield production. Local check, Manakamana-5 variety of maize produced the maximum yield (6.31 t/h) followed by S01SIYQ (5.94 t/h) and Poshilo Makai-1, the standard check (5.91 t/h). As far as heavy rainfall considered, genotypes S01SIWQ-2 (6.46 t/h) and S01SIYQ (6.22t/h) are considered the best since there was heavy rainfall in the vegetative stage of the crop growth (Fig. 1). The top most producer in the trial being non-QPM or normal full season genotype, the latter two are considered to be the best genotyprs among the tested ones and hence promoted to the farmer's field trials in the year 2014.

Figure 4. Grain yield produced from the QPM genotypes in the year 2012 and 1013 in research block of RARS, Lumle at an altitude of 1750 masl.



CONCLUSIONS

Manakamana-5 (local check) was earlier than other entries in the phonological aspects. S99TLWQ-B (163.6 cm) was found the dwarf genotype followed by S00TLWQ-B (168.6 cm) and Poshilo Makai-1 (177 cm). S99TLWQ-B (79.6 cm) followed by S00TLWQ-B (84.9 cm) and S01SIWQ-2 (86.7 cm) had least ear placement height. Genotype Manakamana-5 (6.3 t/h) produced more grain yield followed by S99TLWQ-B (5.9 t/h), Poshilo Makai-1 (5.9 t/h) and S01SIWQ-2 (5.8 t/h). Manakamana-5 being non-QPM improved maize and the latter three genotypes being equally productive, will be promoted in the farmers field trials for further verification of yield and farmer's suitability and local adaptability.

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