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TRANSPLANTING DATES AND NITROGEN LEVELS INFLUENCES ON GROWTH, YIELD ATTRIBUTES, AND YIELD OF SUMMER PEARL MILLET

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ABSTRACT
The experiment was taken with three dates of transplanting viz, Normal drilling at RSD (T_1), first transplanting (Transplanting on RSD, T_2) and second transplanting (Transplanting 25 days after RSD, T_3) and four levels of nitrogen viz., 75% RDN (N_1), 75% RDN + *Azospirillum* (N_2), 100% RDN (N_3), and 125% RDN (N_4). Treatment T_1 recorded significantly higher plant height (178.69 cm) length of earhead (21.79 cm), girth of earhead (9.71 cm), test weight (9.01 g), grain yield (35.90 kg ha^{-1}) and straw yield (92.11 kg ha^{-1}), and found statistically at par with treatment T_2. Among nitrogen levels Significantly higher length of earhead (22.25 cm), girth of earhead (9.79 cm), test weight (9.10 g), grain yield (37.93 kg ha^{-1}) and straw yield (94.45 kg ha^{-1}) were recorded under treatment N_4 but in case of length of earhead and grain yield, treatment N_4 did not differ significantly with N_3. Hence, summer pearlmillet crop should be sown by normal drilling or transplanting on RSD with 100% RDN.

INTRODUCTION

Pearl millet (*Pennisetum glaucum* L.) is one of the major cereal crop grown in arid and semiarid region of the world among the major food grain crop of India. Pearl millet is the most drought tolerant of all domesticated cereals and can yield grain under rainfall as low as 200 to 250 mm (Bidinger and Hash, 2003) making it one the reliable cereals in the direct rain fed regions of the arid and semi-arid tropics. India is the largest producer of this crop, both in terms of area 8.79 million ha with total production 7.95 MT and with an average productivity of 1164 kg ha^{-1}. Rajasthan shares 58.05%, Maharashtra 11.61% and Gujarat 7.55% of India for pearl millet (Anonymous, 2012-13).

Early crops are important to farmers as they break the hunger gap, transplanting early crops breaks this gap two to three weeks earlier and yield more (often double) than normal direct-sown crops, providing food when it is in short supply and very expensive in the market place. Transplanting of seedling increase the yield and also compensate the yield losses due to delay sowing. (Upadhyay *et al.*, 2001).

Poor soil fertility and erratic rains are the most important constraints to crop production in arid and semi arid region. Soil fertility management *i.e* nutrient management particularly nitrogen plays a major role in increasing production and productivity of pearl millet. Nitrogen (N) is an essential nutrient and key limiting factor in crop production of different agro-ecosystems. Nitrogen is considered as one of the most important plant nutrients for growth and development of crop plant. It also plays an important role in synthesis of chlorophyll and amino acids that contribute to the building unit of protein and thus, growth of plants. Nitrogen helps in early establishment of leaf area capable of photosynthesis. Pearl millet is an exhausting crop and heavy consumer of plant nutrients. Nitrogen promotes leaf and stem growth rapidly which consequently increase the yield and its quality.Nitrogen is the major nutrient required by pearl millet which positively increases the growth attributes, length and width of panicle, test weight, number of grain panicle^{-1}, grain weight panicle^{-1} and finally improve the yield (Prasad *et al.*, 2014a). Keeping the importance of pearl millet sowing and transplanting date and importance of nitrogen fertilizer, an experiment was conducted to assess the yield attributes, yield and protein content of pearl millet cultivars with nitrogen levels under agri-hortisystem at Vindhyan region.

The paper deals with the effect of transplanting dates and nitrogen levels on growth yield attributes and yield of pearl millet.

MATERIALS AND METHODS

A field experiment was conducted during summer season of

2013-14 at the college farm, N. M. College of Agriculture., Navsari Agricultural University, Navsari.The soils of south Gujarat are locally known as 'Black Cotton Soil'. The soil of Navsari campus falls under the great group *Ustochrepts,* these soils are dominated by montmorillonite clay, which cracks heavily after drying. Data on soil analysis revealed that soil of experimental field was clayey in texture, medium in available nitrogen (176 kg ha^{-1}) and phosphorus (32 kg ha^{-1}) and high in available potassium (350 kg ha^{-1}). The soil was slightly alkaline in reaction with normal electrical conductivity.

Twelve treatment combinations were laid out in a factorial randomized block design (FRBD) with three replications with three dates of transplanting viz, Normal drilling at recommended date of sowing T_1, first transplanting (Transplanting on recommended sowing date) T_2 and second transplanting (Transplanting 25 days after recommended sowing date) T_3 and four levels of nitrogen (75% RDN, 75% RDN + *Azospirillum*, 100% RDN and 125% RDN) with recommended dose of 120:60:00 kg N:P:K ha^{-1}. Seeds of pearl millet variety GHB-558 were used for sowing. For the treatment N_2 (75% RDN + *Azospirillum*) in normal drilling the seeds of pearl millet were soaked in water for overnight and dressed with *Azospirillum* culture @ 20g/kg of seed as prescribed by Pathak and Charaborti (2014).Application of *Azospirillum* for the treatment $N_2$was also given to the seedlings of pearl millet by the method of seedling dipping as prescribed by Muraleedharan *et al.* (2010) for the transplanting treatments. Normal drilling was done on 12th March, First transplanting was done on 13th March (nursery 25 days before normal drilling) and second transplanting was done on 4th April (nursery on the date of recommended sowing times) during 2013 with recommended seed rate of 4 kg ha^{-1} in each plot manually as per treatments at 45 cm x 10 cm spacing. Half of the nitrogen as per the treatment was applied at the time of sowing and remaining half was top dressed 20 days after sowing. The statistical analysis of data recorded for different characters during the course of investigation was carried out through the procedure appropriate to the Factorial Randomized Block Design of the experiment as described by Panse and Sukhatme, 1967.

RESULTS AND DISCUSSION

Growth parameters

Effect of transplanting dates

Different techniques and dates of transplanting showed remarkable influence on crop growth (Table 1). Treatment normal drilling (T_1) registered significantly higher plant height (178.69 cm), leaf area index (2.60 dm^2), dry matter accumulation $plant^{-1}$ (95.96 g) and number of effective tillers $plant^{-1}$ (5.00) however, treatment T_1 did not differ significantly with T_2 in case of plant height, dry matter accumulation $plant^{-1}$ and number of effective tillers $plant^{-1}$. Normal drilling recorded maximum days to 50% flowering (59.90) and days to maturity (83.56). This is due to early sown crop may enjoy favourable climatic condition in term of temperature and other climatic parameters during various crop growth stages, which reflected into better growth. Similar results of summer pearl millets were also observed by Upadhyay *et al.* (2001), Andhale *et al.* (2007), Radhouane (2008), Ali *et al.* (2013) in pearl millet and by Pawade (2010) in maize. Variations in days to 50% flowering due to dates of transplanting fails to exert it's significant effect which might be due to flowering of plant depends on the length of photoperiods and hormonal factors and these factors unaffected by date of transplanting. The results are in conformity with those reported by Rathore and Gautam (2003a).

Effect of nitrogen levels

The variable performance of pearl millet was recorded with nitrogen levels on growth parameters (Table 1). Significantly higher plant height (178.47 cm), leaf area index (2.51 dm^2), dry matter accumulation $plant^{-1}$(97.07 g) and number of effective tillers $plant^{-1}$(5.03)were observed under application of 125% RDN (Recommended dose nitrogen) and found statistically at par with 100% RDN and 100% RDN + *Azospirillum* (Table 1). These treatments proved superior because nitrogen application improves the the availability of

Table1: Effect of dates of transplanting and levels of nitrogen on growth and growth attributes of summer pearl millet

Treatments	Plant height (cm)	Leaf area index	Dry matter accumulation(g)	Number of effective tillers	Days to 50% flowering	Days to maturity
Dates of transplanting						
T_1	178.69	2.60	95.96	5.00	59.90	83.56
T_2	168.78	2.27	92.75	4.68	58.96	81.26
T_3	164.91	2.16	86.64	4.43	57.66	79.10
SEm. ±	3.70	0.065	2.44	0.15	1.69	1.59
CD (P=0.05)	10.88	0.19	7.15	0.44	NS	NS
Levels of nitrogen						
N_1	161.47	2.16	85.69	4.30	58.33	77.43
N_2	169.25	2.32	90.24	4.66	57.68	80.33
N_3	172.95	2.32	94.14	4.83	59.29	82.44
N_4	179.51	2.51	97.07	5.03	60.05	85.03
SEm. ±	4.28	0.075	2.81	0.17	1.95	1.84
CD (P=0.05)	12.56	0.22	8.26	0.51	NS	5.40
Interaction (T X N)						
SEm. ±	7.42	0.13	4.88	0.30	3.39	3.19
CD (P=0.05)	NS	NS	NS	NS	NS	NS

T_1: Normal drilling on recommended sowing date, T_2: Transplanting on recommended sowing date, T_3: Transplanting 25 days after recommended sowing time, N_1 :75% RDN, N_2 : 75% RDN + *Azospirillum*, N_3 : 100% RDN, N_4 :125% RDN

Table 2: Effect of dates of transplanting and levels of nitrogen on yield attributes and yields of summer pearl millet.

Treatments	Length of earhead (cm)	Girth of earhead (cm)	Test Weight(g)	Grain yield(q ha^{-1})	Straw yield(q ha^{-1})
Dates of transplanting					
T_1	21.79	9.71	9.01	35.90	92.11
T_2	20.06	9.36	8.32	33.21	85.83
T_3	18.82	8.98	7.82	30.65	79.38
SEm. ±	0.79	0.168	0.27	0.97	3.42
CD (P=0.05)	2.33	0.49	0.79	2.85	10.02
Levels of nitrogen					
N_1	18.53	8.82	7.77	28.89	78.19
N_2	19.13	9.36	8.21	31.39	82.92
N_3	21.00	9.43	8.45	34.82	87.66
N_4	22.25	9.79	9.10	37.93	94.45
SEm. ±	0.92	0.19	0.31	1.12	3.95
CD (P=0.05)	2.69	0.57	0.91	3.29	11.57
Interaction (T X N)					
SEm. ±	1.59	0.342	0.54	1.94	6.87
CD (P=0.05)	NS	NS	NS	NS	NS

T_1: Normal drilling on recommended sowing date, T_2: Transplanting on recommended sowing date, T_3: Transplanting 25 days after recommended sowing time, N_1: 75% RDN, N_2: 75% RDN + *Azospirillum*, N_3: 100% RDN, N_4: 125% RDN

nitrogen to the crop which increases the plant growth foliage. The superiority of this treatment over the rest of treatment was due to higher availability of NO^{-3} N and production of growth promoting substance. These results are in close conformity with those of Gautam and Kaushik (1988) and Prasad *et al.* (2014b).

Yield attributes and yield

Effect of transplanting dates

Pearl millets sown by normal drilling (T_1) gave significantly higher length of earhead (21.79 cm), girth of earhead (9.71 cm), test weight (9.01 g), grain yield (35.90 kg ha^{-1}) and straw yield (92.11 kg ha^{-1}), and found statistically at par with first date of transplanting (T2), while lowest length of earhead (18.82 cm), girth of earhead (8.98 cm), test weight (7.82 g), grain yield (30.65 kg ha^{-1}) and straw yield (79.38 kg ha^{-1}) were found in second date of transplanting (Table 1). The magnitude of increase in grain yield kg ha^{-1} under T_1 and T_2 were 17.28 and 8.35%, respectively over T_3. This might be due to higher moisture availability for crop owing to better moisture conservation, due to more vegetative growth resulting from efficient utilization of nutrients, water, radiation and increased metabolic activities followed by increased translocation towards above mentioned yield contributing characters under normal drilling. These results corroborated the findings of Rathore and Gautam (2003b), Rathore *et al.* (2006) Radhouane (2008) and Ali *et al.* (2013).

Effect of nitrogen levels

Significantly maximumlength of earhead (22.25 cm), girth of earhead (9.79 cm), test weight (9.10 g), grain yield (37.93 kg ha^{-1}) and straw yield (94.45 kg ha^{-1}) was recorded under 125% RDN (Recommended dose of nitrogen) but in case of girth of earhead, test weight and straw yield, treatment 125% RDN found at par with 100% RDN and 75% RDN + *Azospirillium*, while in case of length of earhead and grain yield, treatment 125% RDN did not differ significantly with 100% RDN (Table 2). The response of pearl millet to applied nitrogen might be ascribed to the favourable effect of nitrogen application on yield and yield-attributing characters. This might be due to the fact that nitrogen led to higher availability of nutrient that promoted growth and development and ultimately resulting in increasing yield attributes and yield. Application of nitrogen fertilizer provides grater and prolonged availability of nutrients to the crop. Bhuva and Sharma (2015), Lal and Hooda (1993), Prasad *et al.* (2014b) and Bhuva and Sharma (2015) also reported higher grain yield of pearl millet at higher level of nitrogen application.

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