

Screening of wheat varieties and associated bacterial population in old alluvial soil of Burdwan, West Bengal

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(Received: October 16, 2004 ; Revised received: September, 15, 2005 ; Accepted: October 18, 2005)

Abstract: In order to screen out the best variety of wheat (*Triticum aestivum*) out of eight varieties (viz., HP 1633, BW 11, NW 1014, Sonalika, HUW 468, K 9107, HP 1731 and HUW 234), a field experiment was conducted (from Dec. 2002 to April 2003) in a randomized block design replicated thrice at Crop Research and Seed Multiplication Farm, Burdwan University, West Bengal, India. Various morpho physiological parameters viz., plant population, length of shoot and root, leaf area index (LAI), crop growth rate (CGR), leaf area ratio (LAR), leaf area duration (LAD), net assimilation rate (NAR), yield attributes viz., length of panicles, number of grains per panicle, grain yield, straw yield, pigment content in flag leaf (chlorophyll a, b and total chlorophyll and carotenoid content) were estimated and analyzed statistically. Soil bacterial populations were also estimated in the fallow land before sowing of seeds and after harvesting of crop. The HUW 468 variety records higher grain yield, maximum panicle length and maximum chlorophyll b and total chlorophyll content.

Key words: Wheat, *Triticum aestivum*, Alluvial soil, Morpho physiological parameters, Yield attributes, Bacterial population

Introduction

Wheat (*Triticum aestivum*) is an important food crop being next to rice and contributes about 25% to the total food grain production of the country. In West Bengal, only after the introduction of high yielding varieties in the early seventies wheat became an important crop and is grown extensively after rice on land, which is left either fallow or put under boro rice. For getting the maximum yield the choice of the variety plays a very important role. Agarwal and Kalra (1994) proposed a mechanistic crop growth stimulation model whereas information on genetics of the rate of grain filling in wheat was highlighted by Mashiringwani *et al.* (1994). Apart from these research works, effect of high nitrogen supply to crop yield, backcross breeding and identification of soil microbial community of a wheat field were studied by Paltra and Fillery (1995), Smith *et al.* (2000) and Tiwari *et al.* (2001). The objective of this present project was to screen out the best variety of wheat out of eight varieties in relation to grain production under this agro climatic conditions of old alluvial soil zone of Burdwan and subsequently transfer these seeds to local farmers for commercial production with an idea that soil bacteria is an integral part of crop ecosystem.

Materials and Methods

A field experiment was conducted during December 2002 to April 2003 at Crop Research and Seed Multiplication Farm of Burdwan University, West Bengal. The experiment was conducted in randomized block design with three replications. Individual plot size was 5m x 2.5m. Crop varieties were HP 1633, BW 11, NW 1014, Sonalika, HUW 468, K 9107, HP 1731 and HUW 234. Chemical fertilizer was applied at the recommended dose (20:40:20). Weekly mean maximum temperature in the crop

season varied from 23.17 to 36.19°C and minimum varied from 8.68 to 22.14°C. Total rainfall occurred during the entire cropping period was 33.34 mm (Table 1). Hydrogen ion concentration of experimental plots was measured by pH meter whereas estimation of organic carbon (%) (Walkley and Black, 1934), available phosphate (Bray and Kurtz, 1945) and available potash (Jackson, 1967) were carried out before sowing of seeds (Table 2). The observations on morphology, growth attributes, yield attributes and yield were taken at various stages of crop growth. Plant population, leaf area index (LAI), crop growth rate (CGR), leaf area ratio (LAR), leaf area duration (LAD), net assimilation rate (NAR), were estimated by following the methods of Watson (1950). Apart from these, length of shoot (cm) and root (cm), length of panicles (cm), number of grains per panicles, grain yield (g m⁻²) were estimated. Estimations of plant pigments were done by the method of Arnon (1949) whereas estimation of most probable number (MPN) of bacterial population in soil samples before and after harvesting of crop was recorded through dilution plating technique. Statistical methodology as published by Gomez and Gomez (1984) was used.

Results and Discussion

From the experimental results maximum plant population/m² was observed in HP 1731 variety (Table 3). The statistical calculations showed significant differences among the tested varieties, under this agro climatic condition. The length of shoot and root was recorded on 75 DAS (days after sowing). The shoot and root length varied between 88.63-99.75 cm and 14.30-15.83 cm respectively. Among the varieties, Sonalika showed the best performance (Table 3) and also statistically significant at 5% level of significance. LAI is the functional size

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Table - 1: Climatological details (week wise) during the period of experiment

| Month | Standard week | Mean temperature (°C) | | RH(%) | Mean atmosphere pressure(millibar) | Mean sunshine (hrs) | Rainfall (mm) |
|------------|------------------|-----------------------|-------|-------|------------------------------------|---------------------|---------------|
| | | Max | Min | | | | |
| Dec. 2002 | 1 st | 26.54 | 11.50 | 72.28 | 1016.51 | 7.76 | 0 |
| | 2 nd | 26.49 | 12.21 | 73.57 | 1015.85 | 7.69 | 0 |
| | 3 rd | 26.27 | 13.98 | 71.14 | 1016.97 | 6.98 | 0 |
| | 4 th | 25.80 | 12.40 | 88.00 | 1016.60 | 8.05 | 0 |
| Jan. 2003 | 5 th | 23.17 | 10.81 | 82.43 | 1017.74 | 6.44 | 0 |
| | 6 th | 23.17 | 8.68 | 69.14 | 1016.67 | 7.32 | 0 |
| | 7 th | 25.21 | 8.74 | 65.28 | 1018.60 | 9.24 | 0 |
| | 8 th | 26.14 | 10.41 | 53.00 | 1014.42 | 7.60 | 0 |
| | 9 th | 26.70 | 11.1 | 72.33 | 1014.26 | 7.73 | 0 |
| Feb. 2003 | 10 th | 26.91 | 12.22 | 52.85 | 1014.28 | 8.78 | 0 |
| | 11 th | 29.47 | 14.05 | 62.42 | 1016.64 | 8.28 | 0 |
| | 12 th | 31.50 | 16.22 | 60.71 | 1012.70 | 8.21 | 0 |
| | 13 th | 32.30 | 20.36 | 60.33 | 1012.80 | 9.46 | 0 |
| March 2003 | 14 th | 30.74 | 16.50 | 59.42 | 1017.97 | 7.62 | 3.88 |
| | 15 th | 34.47 | 18.75 | 48.28 | 1012.87 | 8.69 | 1.30 |
| | 16 th | 35.91 | 20.43 | 58.57 | 1009.92 | 8.09 | 5.1 |
| | 17 th | 35.80 | 21.35 | 64.00 | 1008.18 | 7.00 | 3.86 |
| April 2003 | 18 th | 33.60 | 19.30 | 71.00 | 1011.90 | 6.20 | 19.20 |
| | 19 th | 36.19 | 22.14 | 69.28 | 1011.08 | 7.93 | 0 |

Table - 2 : Chemical properties of the experimental soil

| Varieties | pH | Organic carbon (%) | Available phosphate (kg/ha) | Available potash (kg/ha) |
|-----------|------|--------------------|-----------------------------|--------------------------|
| HP-1731 | 5.87 | 0.818 | 156.7 | 384 |
| K-9107 | 6.04 | 0.742 | 150.3 | 306 |
| HUW-468 | 5.88 | 0.772 | 140.4 | 336 |
| SONALIKA | 5.83 | 0.757 | 197.8 | 378 |
| NW-1014 | 6.00 | 0.757 | 105.6 | 264 |
| BW-11 | 5.85 | 0.833 | 114.5 | 300 |
| HP-1633 | 6.06 | 0.742 | 125.8 | 330 |
| HUW-234 | 5.85 | 0.742 | 124.4 | 342 |

of the crops standing on land area. The LAI value was recorded on 45, 60 and 75 DAS. The maximum value of LAI on 45 DAS, 60 DAS and 75 DAS was recorded from HUW 234, BW 11 and HP 1731 varieties respectively. In all the cases data showed statistically significant results at 5% level of significance which suggests that there were clear difference in LAI values among all the varieties tested under this agro climatic condition of old alluvial soil zone of Buurdwan, West Bengal. Results of other morpho physiological parameters such as CGR, LAR, LAD and NAR are represented in Table 4. All those values were recorded in two phases, one between 45-60 DAS and the other between 60-75 DAS. The CGR is a simple and important index of agriculture productivity on rate of dry matter production. The CGR values varied between 0.42-0.49 ($\text{g m}^{-2}\text{d}^{-1}$) in the 1st phase (maximum in NW 1014) and between 0.12-0.19 ($\text{g.m}^{-2}\text{d}^{-1}$) in the

Table - 3: Plant population, length of shoot and root and leaf area index (LAI)

| Variety | No. of plants/m ² | Length of shoot at 75 DAS (cm) | Length of root at 75 DAS (cm) | Leaf area index (LAI) | | |
|---------------|------------------------------|--------------------------------|-------------------------------|-----------------------|----------|---------|
| | | | | 45 DAS | 60 DAS | 75 DAS |
| HP 1633 | 321.21 | 90.75 | 14.90 | 2.08 | 3.17 | 5.69 |
| BW 11 | 372.71 | 88.63 | 14.30 | 2.38 | 3.86 | 5.61 |
| NW 1014 | 377.82 | 97.24 | 15.26 | 2.36 | 3.67 | 5.49 |
| Sonalika | 362.97 | 99.75 | 15.83 | 2.23 | 3.66 | 5.74 |
| HUW 468 | 389.20 | 98.26 | 15.50 | 2.25 | 3.60 | 5.52 |
| K 9107 | 332.22 | 89.73 | 14.98 | 2.12 | 3.57 | 5.62 |
| HP 1731 | 390.00 | 88.75 | 14.76 | 2.29 | 3.34 | 5.80 |
| HUW 234 | 388.04 | 97.22 | 15.32 | 2.42 | 3.66 | 5.56 |
| SEM (\pm) | 0.0244 | 0.0896 | 0.1513 | 0.1505 | 0.1833 | 0.0928 |
| C.D. (5%) | 0.0740 | 0.2717 | 0.0045 | 0.4564 | 0.5559 | 0.33027 |
| C.V. (%) | 2.7184 | 3.6358 | 6.7437 | 17.322 | 16.81002 | 6.77 |

Table - 4: Crop growth rate (CGR), leaf area ratio (LAR), leaf area duration (LAD) and net assimilation rate (NAR)

| Variety | CGR (g.m ² .d ⁻¹) | | LAR (cm ² .g ⁻¹) | | LAD (days) | | NAR (g.m ⁻² .d ⁻¹) | |
|-----------|--|--------|---|---------|------------|---------|---|--------|
| | 45-60 | 60-75 | 45-60 | 60-75 | 45-60 | 60-75 | 45-60 | 60-75 |
| | DAS | DAS | DAS | DAS | DAS | DAS | DAS | DAS |
| HP 1633 | 0.43 | 0.12 | 7.91 | 12.80 | 43.76 | 58.98 | 0.16 | 1.73 |
| BW 11 | 0.43 | 0.15 | 6.76 | 12.03 | 44.12 | 69.92 | 0.013 | 3.42 |
| NW 1014 | 0.49 | 0.14 | 7.24 | 10.68 | 45.33 | 64.05 | 0.015 | 1.38 |
| Sonalika | 0.47 | 0.13 | 8.32 | 11.59 | 44.37 | 72.14 | 0.012 | 1.16 |
| HUW 468 | 0.44 | 0.18 | 7.08 | 11.43 | 44.45 | 65.09 | 0.022 | 1.55 |
| K 9107 | 0.43 | 0.16 | 6.04 | 10.79 | 56.20 | 64.94 | 0.013 | 1.41 |
| HP 1731 | 0.42 | 0.14 | 6.23 | 12.03 | 55.95 | 65.36 | 0.012 | 1.25 |
| HUW 234 | 0.44 | 0.19 | 7.16 | 11.47 | 45.65 | 65.44 | 0.014 | 1.60 |
| SEM (±) | 0.0129 | 0.013 | 0.3493 | 0.2589 | 0.2351 | 0.1223 | 0.0057 | 0.1366 |
| C.D. (5%) | 0.0391 | 0.0965 | 1.0594 | 0.7852 | 0.7130 | 0.3709 | 0.0172 | 0.4143 |
| C.V. (%) | 3.3567 | 6.1398 | 22.72 | 13.1642 | 5.9116 | 2.61323 | 8.2760 | 8.2167 |

Table 5: Length of panicle, number of grains/panicle, test weight, grain yield and straw yield

| Variety | Length of panicle (cm) | No. of grains/panicle | Test weight | Grain yield (g/m ²) | Straw yield (g/m ²) |
|-----------|------------------------|-----------------------|-------------|---------------------------------|---------------------------------|
| HP 1633 | 14.41 | 39.90 | 31.42 | 311.66 | 367.44 |
| BW 11 | 14.80 | 40.32 | 43.20 | 371.66 | 503.17 |
| NW 1014 | 15.04 | 40.65 | 31.41 | 401.66 | 507.17 |
| Sonalika | 16.24 | 46.89 | 41.88 | 463.33 | 482.15 |
| HUW 468 | 16.32 | 49.53 | 40.94 | 500.00 | 526.45 |
| K 9107 | 16.11 | 41.53 | 31.19 | 433.33 | 445.43 |
| HP 1731 | 15.29 | 40.76 | 40.15 | 416.66 | 565.83 |
| HUW 234 | 15.40 | 40.94 | 38.02 | 430.00 | 528.33 |
| SEM (±) | 0.3265 | 0.2408 | 0.1414 | 1.2630 | 0.4303 |
| C.D. (5%) | 0.9902 | 0.7303 | 0.4289 | 3.8307 | 1.3051 |
| C.V. (%) | 8.308 | 3.6935 | 2.3164 | 2.8305 | 1.9419 |

Table - 6: Chlorophyll and carotenoids content (mg.g⁻¹ f.w) in flag leaf on 100 DAS

| Variety | Chl 'a' | Chl 'b' | Total chlorophyll | Carotenoids |
|-----------|---------|---------|-------------------|-------------|
| HP 1633 | 1.5681 | 1.366 | 3.2763 | 0.5109 |
| BW 11 | 1.811 | 1.335 | 2.8151 | 0.5572 |
| NW 1014 | 1.311 | 1.223 | 3.9787 | 0.3555 |
| Sonalika | 1.275 | 1.372 | 3.1872 | 0.3121 |
| HUW 468 | 1.375 | 1.415 | 4.0025 | 0.3548 |
| K 9107 | 1.4828 | 1.335 | 2.5709 | 0.4689 |
| HP 1731 | 1.775 | 1.301 | 3.1451 | 0.3031 |
| HUW 234 | 1.6840 | 1.348 | 2.9456 | 0.4761 |
| SEM (±) | 0.076 | 0.155 | 0.1722 | 0.0479 |
| C.D. (5%) | 0.232 | 0.471 | 0.5223 | 0.1452 |
| C.V. (%) | 6.204 | 13.442 | 9.5109 | 7.4148 |

2nd phase (maximum in HUW 238). With respect to LAR and LAD on 60-75 DAS highest value was recorded from HP1633 and sonalika variety respectively. NAR is related to photosynthetic activities of leaf *i.e.* rate of increase in dry weight of whole plant/unit leaf area. Both the 1st and 2nd phase values varied between 0.012-0.022 (g m².d⁻¹) and 1.16-3.42 (g m².d⁻¹) respectively. In both the stages of crop growth, CGR, LAD and NAR values were statistically significant at 5% level of significance. Therefore clear

differences in CGR, LAD and NAR values among all the varieties were observed. Estimated results of other parameters such as length of panicles, no. of grains per panicle, test weight, grain yield and straw yield, are represented in Table 5. Both panicle length and number of grains per panicle were recorded maximum in HUW 468 variety thereby indicating positive correlation between the two parameters. Maximum test weight was observed in BW 11 and minimum in K 9107 variety. Regarding straw yield maximum yield was observed from HP 1731 variety but grain yield was found maximum in HUW 468. The data on plant population /m² correlates with straw yield. Estimated data of panicle length, no. of grains per panicle, test weight of grains, grain yield and straw yield were statistically significant for all the varieties. The completed data on the level of chlorophyll (chlorophyll a, b and total chlorophyll) and carotenoids are shown in Table 6. From the tabulated data it appeared that maximum accumulation of chlorophyll a and b were recorded from BW 11 and HUW 468 respectively. But with respect to the level of total chlorophyll, maximum accumulation was found in HUW 468. From the level of chlorophyll content in physiologically active leaf, maximum accumulation in HUW 468 showed its reflection in the seed yield because maximum seed yield occurs in this variety. This indicates that due to higher biosynthesis of chlorophyll and photosynthesis in flag leaf of HUW 468 plants, maximum transfer



Table - 7: Soil bacterial population (cfu) in the experiment field before and after the experiment

| Varieties | Result |
|-----------------------|--------------------|
| Before the experiment | |
| Fallow land | 30x10 ⁶ |
| After the experiment | |
| HP 1633 | 27X10 ⁵ |
| BW 11 | 29X10 ⁵ |
| NW 1014 | 22X10 ⁵ |
| Sonalika | 37X10 ⁵ |
| HUW 468 | 25X10 ⁵ |
| K 9107 | 28X10 ⁵ |
| HP 1731 | 26X10 ⁵ |
| HUW 234 | 27X10 ⁵ |

of photosynthate from flag leaf to the panicle occurred in this variety. Total chlorophyll content also showed significant difference among the different varieties. The impact of chloroplast biosynthesis on seed yield and straw yield is not in conformity with other varieties. This may be due to source sink transport of food material for grain filling which is different among all the varieties tested in this studies.

Apart from chlorophyll, carotenoid content in the leaf tissue was also estimated and significant accumulation was found from all the varieties. Soil bacterial population was counted in the soil of the experimental plot before and after the cultivation of the crop. The results were investigated in six varieties by counting soil bacterial colony (Table 7). As the bacterial populations decreased in the chemical fertilizer treated plots it is clear that chemical fertilizer have an impact on soil bacterial population.

From this study, it may be concluded that the best variety under this agroclimatic zone is HUW 468 but it should be

cultivated with combined dose of chemical + biofertilizer/ organic manure to reduce its impact on soil biodiversity of microflora.

Acknowledgments

Authors are very much thankful to the Director, Nitrofix Laboratory, Kolkata and to the University authority for providing an experimental plot at Crop Research and Seed Multiplication Farm, University of Burdwan-713 104 to carry out the experiment.

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