



## SHORT COMMUNICATION

# INCLUSION OF POTATO FOR INTENSIFICATION OF COTTON-WHEAT CROPPING SYSTEM IN NORTHWESTERN PLAINS: A PHYSIOLOGICAL STUDY

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A Field experiment was conducted during 2005-06 to test the suitability and adaptability of cotton, potato and wheat genotypes for cotton based system. Highest seed-cotton yield was recorded in LHH 144 (2.3-2.6 t ha<sup>-1</sup>) followed by Ankur 651 (2.2 t ha<sup>-1</sup>) and lowest in CNH 36 (1.9 t ha<sup>-1</sup>). This was associated with boll weight, which was significantly higher in LHH 144. Among potato genotypes, Kufri Pukhraj had significantly higher tuber yield and total biomass productivity than Kufri Surya, largely due to higher LAI in Kufri Pukhraj. However, tuber dry matter (%) and photosynthesis rate were invariably higher in Kufri Surya ( $\geq 19\%$  and  $20.6 \mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$ , respectively) than in Kufri Pukhraj ( $\leq 16\%$  and  $19.4 \mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$ ). In wheat, grain yield was significantly reduced in PBW 343 (13 %) under late sowing (40 days) after the harvest of potato as compared with the normal sowing. This was mainly due to reduction in biomass and leaf area. The results indicate that early maturing cotton genotypes (Ankur 651 and LHH 144) and potato genotypes (Kufri Pukhraj and Kufri Surya) could provide opportunities for the intensification of cotton-wheat system by inclusion of potato in northwestern plains in system mode.

**Key words:** Biomass, boll number, cotton-potato-wheat system, grain yield, LAI, net returns, photosynthesis, tuber yield.

Cotton is largely grown as monocrop under rainfed conditions. It is also grown as cotton-wheat double cropping under irrigated conditions in north India. Area and productivity of cotton-wheat cropping system has, however, declined during last decade (Bhandari *et al.* 1998). This, in general, is attributed to longer duration of cotton crop, which imposes a restriction on the inclusion of this crop in a system mode with crops like potato and wheat. With the improvements in production technologies and development of short duration genotypes of cotton and wheat the productivity of cotton-wheat system has been increased up to 10 t/ha (Singh *et al.* 2004). However, maximum net return from this system is far below as compared to other cotton based

cropping system. The productivity of cotton-wheat system could be further increased with the intensifications of this system by introducing potato, a high value commercial crop. Keeping this in view attempts were made to evaluate the early maturing genotypes of cotton and potato under in system mode with wheat.

Under collaborative research programme of PDCSR and CPRI, a field experiment was conducted at Project Directorate for Cropping Systems Research, Modipuram, Meerut in RBD with 3 replications. Eight cotton-potato-wheat systems (T1-Ankur 651-Kufri Surya-PBW 373, T2-Ankur 651-Kufri Pukhraj-PBW 373, T3-CNH 36-

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Kufri Surya–PBW 373, T4–CNH36–Kufri Pukhraj–PBW 373, T5–LHH144–Kufri Surya–PBW 373, T6–LHH144–Kufri Pukhraj–PBW 373, T7–LHH 144–Kufri Surya–PBW 343 and T8–LHH144–Kufri Pukhraj–PBW 343) were compared with two cotton-wheat systems (T9–LHH 144–PBW 373 and T10–LHH 144–PBW 343). Cotton was grown in *kharif* 2005 and potato was sown after harvesting of cotton on September 30 and October 15, thereafter wheat was sown after harvesting of cotton on November 20, and potato on December 15 & 30 during *Rabi* 2005-06. Leaf area was estimated using leaf area meter (Model LI-3100) and LAI was calculated. In potato, photosynthesis rate was measured by portable photosynthesis system (Model LI-6400) and tuber dry matter content was estimated. Biomass and yields were recorded and overall system's productivity, in terms of wheat equivalent yield (WEY) and net returns were estimated in all the treatments.

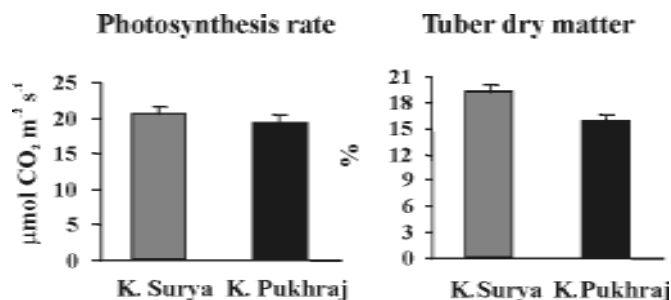
Significant variations occurred in seed-cotton yield and biomass accumulation among different genotypes of cotton (Table 1). Highest seed-cotton yield was recorded in LHH 144 (2.3-2.6 t ha<sup>-1</sup>) followed by Ankur 651 (2.2 t ha<sup>-1</sup>) and lowest in CNH 36 (1.9 t ha<sup>-1</sup>). This was associated with boll weight, which was significantly higher in LHH 144. Variations in harvested boll (numbers plant<sup>-1</sup>) and LAI were not significant (Table 1). Similar results were also reported in our earlier studies (Singh *et al.* 2004). Among potato genotypes, Kufri Pukhraj had significantly higher tuber yield and total biomass than Kufri Surya, largely due to higher LAI in Kufri Pukhraj (Table.1). However, tuber dry matter (%) was invariably higher (>19%) in Kufri Surya than in Kufri Pukhraj (<16%) (Fig.1). Higher tuber dry matter in Kufri Surya could be ascribed to higher photosynthesis rate (20.6 μmole CO<sub>2</sub> m<sup>-2</sup> s<sup>-1</sup>) as compared to Kufri Pukhraj (19.4 μ mole CO<sub>2</sub> m<sup>-2</sup> s<sup>-1</sup>). Potato yield of about 18-21 t

**Table 1.** LAI, biomass and yield of cotton, potato and wheat genotypes and wheat equivalent yield (t ha<sup>-1</sup>) and net returns (Rs. '000' ha<sup>-1</sup>) of different cotton-potato-wheat systems.

Treat ment*	Cotton						Potato				Wheat				WEY	Net return
	Yield	Bolls plant <sup>-1</sup>	Boll Wt. (g boll <sup>-1</sup> )	LAI	Bio- mass	Crop durat- ion (days)	Tuber yield	LAI	Bio- mass	Crop durat- ion (days)	Grain yield	LAI	Bio- mass	Crop durat- ion (days)		
T 1	2.2	27.0	3.1	4.5	5.7	130	20.6	1.3	5.8	73	4.8	3.5	11.3	130	22.7	78.8
T 2	2.3	27.7	3.0	4.4	5.6	130	24.8	3.1	5.6	73	4.9	3.6	10.9	130	25.6	99.6
T 3	2.0	26.7	2.9	5.0	10.2	146	18.6	1.8	4.5	72	4.9	2.8	11.8	115	21.2	72.6
T 4	1.8	26.3	2.8	5.2	10.5	146	25.4	2.3	5.2	72	4.9	3.1	11.9	115	24.4	95.4
T 5	2.4	23.7	4.0	4.6	7.0	146	18.3	1.7	4.8	72	4.7	3.2	11.5	115	22.0	74.3
T 6	2.5	23.0	4.2	4.9	6.6	146	23.8	2.4	5.0	72	4.8	3.3	10.4	115	25.5	97.9
T 7	2.4	24.3	3.9	4.9	6.4	146	18.3	1.5	4.6	72	4.6	3.3	10.9	115	21.8	72.7
T 8	2.3	24.0	4.2	4.6	6.6	146	24.8	2.3	4.9	72	4.7	3.1	10.8	115	25.4	98.1
T 9	2.6	23.7	4.2	4.5	6.5	161	-	-	-	-	5.0	3.8	11.5	141	12.7	50.2
T 10	2.5	24.3	4.2	4.8	6.4	161	-	-	-	-	5.4	3.9	11.7	141	12.8	50.9
CD (0.05)	0.2	NS	0.4	NS	0.7	-	2.9	0.9	0.8	-	0.4	0.4	NS	-	1.6	12.3

\*T1-Ankur 651–K.Surya–PBW 373, T2-Ankur 651–K.Pukhraj–PBW 373, T3–CNH 36–K.Surya–PBW 373, T4–CNH36–K. Pukhraj–PBW 373, T5–LHH 144–K. Surya–PBW 373, T6–LHH 144– K.Pukhraj–PBW 373, T7–LHH144–K.Surya–PBW 343 and T8–LHH 144–K.Pukhraj–PBW 343, T9–LHH 144–PBW 373 and T10–LHH 144–PBW 343.

ha<sup>-1</sup> with >19% tuber dry matter were achieved in Kufri Surya and about 24-25 t ha<sup>-1</sup> with <16% tuber dry matter in Kufri Pukhraj in 70 days. Though, potatoes having >19% tuber dry matter from Kufri Surya are known to fetch premium prices, as these were also suitable for processing (Kumar *et al.*, 2005) but this superiority in tuber quality was not reflected in calculating net returns in the present study. Regarding wheat genotypes, significant variations were observed in biomass, LAI and grain yield (Table 1). Grain yield was significantly reduced in PBW 343 (13 %) under late sowing (40 days) after the harvest of potato as compared with the normal sowing. This was largely due to reduction in biomass and leaf area. On the other hand, PBW 373 performed fairly well both under normal and late sowing, after the potato harvest, as there was no reduction in yield and other growth parameters in this genotype. Singh *et al.* (2004) also reported similar reduction in grain yield of late sown wheat under cotton-wheat system.



**Fig. 1.** Photosynthesis rate at 65 days and tuber dry matter at 70 days after planting in potato genotypes (Averaged over treatments)

Overall system's productivity, expressed in terms of wheat equivalent yield (WEY) and net returns showed significant variations (Table 1) and was lowest in cotton-wheat system (12.8 t ha<sup>-1</sup> and Rs. 50.6 '000' ha<sup>-1</sup>, respectively) as compared to other systems. Among different cotton-potato-wheat systems, highest WEY and net returns (25.6 t ha<sup>-1</sup> and Rs. 99.6 '000' ha<sup>-1</sup>, respectively) were obtained from cotton (Ankur 651)-potato (Kufri Pukhraj)-wheat (PBW 373) followed by

cotton (LHH 144)-potato (Kufri Pukhraj)-wheat (PBW 373) cropping systems. Chittapur (2004) has also reported higher productivity and net return from cotton-potato system. The results indicate that the inclusion of potato in cotton-wheat cropping system has not only increased the total productivity, in terms of wheat equivalent yield (about 22-26 t ha<sup>-1</sup>) as compared the existing cotton-wheat system (13 t ha<sup>-1</sup>) but also found more remunerative (up to 195 % higher). Therefore, early maturing cotton genotypes (Ankur 651 and LHH 144) and potato genotypes *viz.* Kufri Pukhraj and Kufri Surya could provide opportunities for the intensification of cotton-wheat system by introducing potato in system mode in northwestern plains.

## REFERENCES

- Bhandari, A.L., Tirlok, S. and Brar, A.S. (1998). Cotton-wheat. In: R.L. Yadav, K. Prasad and A.K. Singh (eds.), *Predominant Cropping Systems of India: Technologies and Strategies*, pp. 108-21. PDCSR, Modipuram, Meerut, India.
- Chittapur, B.M. (2004). Cotton based cropping system for sustainable productivity. In: B.M. Khadi, H.M. Vamadevai, I.S. Katageri, H.L. Halemani, B.C. Patil and S.S. Hallikeri (eds.), *Proc. Int. Symp. Strategies for Sustainable Crop Production- A Global Vision*, Nov. 23-25, 2004 Vol. 2. *Crop Production*, pp. 45-55. Univ. Agri. Sci., Dharwad, Karnataka.
- Kumar, Devendra, Minhas, J.S., Singh, S.V. and Singh, B.P. (2005). Evaluation of potato hybrid HT/92-621 for processing as French fries. *Potato J.* **32**: 139-140.
- Singh, D., Sharma, S.K., Pandey, R. and Kumar, V. (2004). Suitable genotypes for cotton-wheat system under irrigated conditions of northern plain zone. In: A.K. Singh, B. Gangwar, G.C. Sharma and P.S. Pandey (eds.), *Proc. of 2nd National Symposium on Alternative Farming Systems: Enhanced Income and Employment Generation Options for Small and Marginal Farmers*, September 16-18, 2004, pp. 124-26. PDCSR, Modipuram, Meerut, Uttar Pradesh, India.