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Quantitative and qualitative analysis of effect of maple tree shade on wheat

T. SHAH AND MD. NAUMAN

Department of Agronomy
University of Agriculture
Peshawar, Pakistan

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ABSTRACT

A two years field study regarding to quantitative and qualitative analysis of effect of maple tree shade in wheat was conducted on sandy clay loam soil. The shade treatments comprised no shade, two, three, four, five, six, seven and eight hours daily shade. Shading had adverse effect on all the parameters under study. There was a progressive decrease in plant height, number of spike bearing tillers/unit area, number of grains/spike, 1000-grain weight and seed yield/hectare with each successive increase in shade hour. The seed yield decreased by 0.97 per cent - 9.43 per cent and 13.91-19.83 per cent as a result of daily shade of 2-3and 4-5 hours, respectively. The decline in yield was further intensified when the shade hours were upsurge to 6-7 which was 29.23-45.25 per cent and reached the maximum of 55.71 per cent with 8h shade. The harvest index, dry matter percentage and grain protein contents of shaded plants decreased to a substantial extent as compared to un-shaded plants.

***Keywords*:** *Acer griseum*, shading, wheat, yield components

On the one hand trees play significant role in the economy of our country besides having great meteorological and commercial values, while on the other hand trees growing along the fields affect the growth and yield potential of crop plants under their shade to a considerable extent. According to Rao and Deb (1975) response of rice to fertilizer was decreased by decreasing illumination period, while response to light also decreased with decreasing fertility. They further observed that reduction in light at any growth stage decreased yield. Similarly, Moursi *et al*. (1976) concluded that shading decrease the number of tillers and spikes, dry weight, fruiting efficiency, grain weight per plant and yield of grain and straw. Shade resulted in smaller grains, slower rate of dry matter accumulation in the grains and lower final grain weight (Jenner, 1979). Similarly, Fisher and Stockman (1980) grew four wheat cultivars in pots and subjected them to single shading of 8-11 days within an interval of 36 days before anthesis until anthesis. They found that shading period centered at 10-13 days before anthesis had very reverse effects on grain number per ear through effects on grains per spikelets, this was associated with greatest reductions in the number of competent florets per unit ear dry weight while florets fertility was unaffected. Lenka and Misra (1980) 0bserved that shading rice plants from transplanting up to the panicle initiation stage (44 days) from panicle imitation up to flowering (24), from flowering to maturation (28), during any of these two periods or during all three periods decreased the number of grains per panicle, 1000-grain weight and increased spikelet sterility. Nayak and Murty (1980) reported that a reduction of 75 per cent, 50 per cent or 25 per cent in the normal light intensity decreased average paddy yields of two rice cultivars by 47 per cent; 58 per cent and 54 per cent, respectively, mostly due to decrease in dry matter production, harvest index, panicle per m^2 and grains per panicle.

Asandhi and Suryadi (1982) stated that shading reduce dry matter production, tuber yield and leaf area development of potato. Similarly Dossou-Yovo *et al*. (1982) measured the growth and photosynthetic efficiency of rice from 6-7 leaf stage to maturity and concluded that shading reduce leaf area and grain length, dry matter yield and photosynthesis in all cultivars. The present study was conducted to determine the quantitative and qualitative effects of maple (*Acer griseum* L.) tree shade on the productive potential and growth behavior of wheat under the irrigated condition at Charsadda.

MATERIALS AND METHODS

The study regarding to the growth and yield behavior of wheat as affected by tree shade was carried out at the Agriculture Research Station, Harichand. The experiment was laid out in Randomized Complete Block Design (RCBD) with four replications which were made parallel to the tree lines to maintain uniformity in shade within the replication. Treatments were placed in each replication systematically as there was no provision for randomization because of parallel position of the replications to tree rows. The experiment consists of no shade, 2, 3, 4, 5, 6, 7 and 8 hours daily shade. The crop was sown 30 cm apart paired rows with 15 cm space

Email: tariq.shah94@gmail.com

between the rows of each pair on 5th December and 17th November and harvested on 10th May and 22nd April during 2012-13 and 2014-15, respectively. Observations were recorded on all the relevant parameters by using standard procedures. The data obtained were analyzed by using Fisher's Analysis of variance Technique and Duncan's New Multiple Range Test at 5 per cent level of probability was used to compare the differences among the treatment means (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

The two years results regarding to the various yield and quality parameters of wheat as influenced by different day time shade hours of maple (*Acer griseum* L.) tree growing along the experimental site indicated that there was significant difference in plant height when the shade duration increased beyond the two hours per day and the decrease was in a linear fashion as the duration of shade increased beyond four hours (Table 1). Plant height was maximum (91.97) in no shade plants while minimum (77.69) in plants shaded for 8 hours. The decrease in height shown by shaded plants is due to the quantity of light received by them.

There was progressive decrease in leaf area per tiller with each successive increase in shade/duration up to five hours and later increased significantly. This may due to the longer shade in March which kept the temperature comparatively lower and relative humidity higher thus encouraging the horizontal growth rate of leaves as compared to the plants exposed to sunlight for more part of the day. The increase in leaf area is simply to compensate for the lower intensity of light received by the shaded plants. This increase in the leaf area helps the plant in capturing relatively more light which is required for photosynthesis. The percent decrease over no shade treatment was the maximum (30.19) in five hours shade followed by six hours shade (23.76) as against the minimum (11.10) for two hour shade. This variable behavior in leaf area was probably attributed to changes in the micro-weather elements under the shade. The results reported by Asandhi and Suryadi (1982) and Dossou-Yovo *et al*. (1982) are quite in agreement with these findings.

Table 1: Yield and yield components of wheat as affected by maple tree shading

Shade (hrs)	Plant height (cm)	Leaf area tiller^{-1} (cm^2)	Dry matter (%)	No. of spike m^{-2}	No. of grains spike^{-1}
0	93.97 ^{a}	139.71 ^{a}	36.35 ^{a}	985.88 ^{a}	39.88 ^{a}
2	93.95 ^{a}	127.54 ^{b}	36.22 ^{a}	915.75 ^{b}	37.37 ^{b}
3	92.45 ^{ab}	124.10 ^{bc}	34.12 ^{bc}	863.75 ^{b}	36.81 ^{b}
4	91.60 ^{b}	120.04 ^{c}	34.45 ^{b}	789.88 ^{c}	36.82 ^{b}
5	90.03 ^{b}	102.02 ^{e}	33.38 ^{c}	793.75 ^{c}	35.73 ^{bc}
6	89.71 ^{c}	110.62 ^{b}	31.30 ^{d}	653.63 ^{d}	33.64 ^{c}
7	86.19 ^{d}	124.78 ^{bc}	28.89 ^{e}	596.38 ^{d}	33.14 ^{c}
8	79.69 ^{e}	120.49 ^{c}	28.82 ^{e}	467.63 ^{e}	28.49 ^{d}

Note: Means followed by the same letter do not differ significantly at 5% level of probability (DMRT).

Tree shade decreased dry matter percentage in plants by increasing shade duration. There was almost a continues decrease in dry matter percentage with each successive hour of shade, however, a sharp decrease was observed after five hours shade , while no significant decrease in dry matter percentage was recorded with two hour shade. On the basis of two years average, significant decreased in dry matter percentage was obtained beyond two hours shade which was further intensified with each successive unit of shade. Dry matter contents decreased to 11.47 per cent, 18.11 per cent, 25.80 per cent and 26.02 per cent with a shading duration of 5, 6, 7 and 8 hrs per day, respectively. Dry matter potential of wheat plants decreased considerably by the tree shade as plants grow under the tree shade did not carry on their normal photosynthetic activities because of low availability of sunlight, which ultimately resulted in low carbohydrate synthesis, in the plants. Similar results were reported by Nayak and Murty (1980) and Asandhi and Suryadi (1982).

Wheat grown in unshaded plots produced significantly more spike bearing tillers per unit area linear decrease with each successive hour of shade amounting to 10.19 per cent, 15.53 per cent, 23.11per cent, 22.71per cent, 37.08 per cent, 42.95 per cent and 56.15 per cent as a result of 2, 3, 4, 5, 6, 7 and 8 hours shade, respectively was observed. These results are supported by the findings of Moursi *et al*. (1976) and Rao and Deb (1975).

Number of grains per spike indicated highly significant differences among the various shade treatments in both the years of study. The number of grains per spike was reduced to 9.00-13.57 per cent with an average shade of 2-5h. The decrease was further intensified (19.39-20.78 per cent) with an increase of 6-7hrs shade period and reached the maximum of 35.73 per cent with shade duration of 8 hrs per day. However, the differences among 2-5hrs and 5-7hrs shade treatments were non-significant. Decrease in the number of grains per spike by the shade was also reported by Jenner (1979), Fisher and Stockman (1980), Lenka and Misra (1980) and Nayak and Murty (1980).

The data on 1000-grain weight as influenced by different shading durations showed that there were highly significant differences among all the shading durations (Table 2). The lowest 100-grain weight of 41.37 g was recorded in plots with 8h shade followed by plots with 6-7h shade as against the highest of 49.96 g in plants with no shade. Decrease in 1000-grain weight was 5.07-6.92 per cent, 9.09-11.38 per cent and 12.38-18.51 per cent in plots with 2-3, 4-5 and 7-8 hrs shade, respectively. These results are supported by the findings of Rao and Deb (1975) and Lenka and Misra (1980).

On the basis of two years average data, there was a progressive decrease in grain yield with each successive unit of shade beyond two hours. The difference between 3 and 4 hours shade treatment was non-significant. However, grain yield decreased to 2.97-11.43 per cent per hectare and 15.91-19.83 per cent per hectare as a result of daily shade of 2-3 hrs and 4-5 hrs, respectively. The reduction in the yield was further intensified when the shade hours were increased to 6-7h which amounted to 29.23-45.25 per cent and reached the maximum of 55.71 per cent with 8h shade. These results further led to conclusions that in wheat daily shade beyond two hours started interrupting the normal growth physiology of plants considerably as a result of which the economic yield potential of the crop dropped to a substantial degree. A notable reduction in grain yield as result of shading was attributed to reduced tillering and relatively wider grain straw ratio because of low light duration which probably decreased the rate of photosynthesis and thereby resulted in low net assimilation rate of shaded crop plants. The results reported by Moursi *et al*. (1976), Dossou-Yovo *et al*. (1982), Jenner (1979) and Lenka and Misra (1980) are quite in line with these findings.

Table 2: Yield and yield components of wheat as affected by maple tree shading

Shade (hrs)	1000-grain wt. (g)	Grain yield q ha^{-1}	% decrease shade	Harvest index	Protein content
0	49.96 ^{a}	32.90 ^{a}	-	35.59 ^{e}	14.12 ^{a}
2	48.55 ^{b}	32.61 ^{a}	0.97	37.69 ^{a}	14.11 ^{a}
3	50.70 ^{bc}	30.08 ^{b}	9.43	37.20 ^{bc}	14.00 ^{ab}
4	45.70 ^{c}	28.74 ^{b}	13.91	37.50 ^{ab}	13.88 ^{bc}
5	44.65 ^{cd}	26.97 ^{c}	19.83	36.88 ^{cd}	13.73 ^{c}
6	45.09 ^{cd}	24.16 ^{d}	29.23	36.83 ^{d}	13.66 ^{c}
7	44.19 ^{d}	19.37 ^{e}	45.25	32.76 ^{f}	13.13 ^{d}
8	41.39 ^{e}	16.24 ^{f}	55.71	32.41 ^{g}	12.80 ^{e}

The harvest index of the wheat crop was also influenced significantly by the various durations of shade. The differences among the treatments were inconsistent because of relatively excessive crop growth and lodging in the unshaded plots. It was also observed that overall harvest index values in all the experimental plots were much lower than the normal values as wheat straw was not fully dried at the time of wheat threshing. Asandhi and Suryadi (1982) and Nayak and Murty (1980) also reported a decrease in harvest index due to decrease in light intensity duration.

A perusal of data indicated that the protein content in grains were not influenced significantly up to 3 hour shade but decreased progressively thereafter with each successive hour of shade. The differences among the 4, 5 and 6 hrs shade treatments were also non-significant while 7 and 8 hrs shade treatment differed significantly from each other and from rest of the treatments. A maximum decrease of 13.87 per cent in protein contents was recorded after 8 hrs shade followed by 10.90 per cent with 7 hrs shade as against 6.14, 5.51, 4.16, 3.08 and 2.09 per cent for 6, 5, 4, 3 and 2 hrs shade treatments, respectively over no shade.

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