# SHORT-TERM EFFECT OF SEASONAL BURNING ON THE COMPOSITION OF *DICHANTHIUM ANNULATUM* STANDS AT VARANASI

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The present investigation carried out during the year 1970 at Varanasi on one year experimentation of ungrazed plot with one and two winter and summer burnings shows remarkable changes in species composition in response to fire :

(*a*) The leguminous plants grow vigorously after the first fire, their number increases still further after the second burning.

(*b*) Fire reduces the basal cover of *Dichanthium annulatum*.

(*c*) The commonest winter weeds are completely eliminated or reduced to insignificant level in composition spectrum of the vegetation.

## INTRODUCTION

The purpose of this article is to present a quantitative assessment of the degree to which experimental burning alters the floristic composition of *Dichanthium annulatum* stand in the following season at Varanasi.

## THE STUDY SITE

The study site is located in a protected plot of the Botanical Garden within the campus of Banaras Hindu University which is about 5 kilometers south of Varanasi city (25° 18′ north latitude and 83° 1′ east latitude). It is situated in the upper Gangetic plains near the west bank of Ganges river. The ground is level and the mean height from the sea level is approximately 76.19 m. Geographically the area is subtropical but hot summers modulated by monsoon and mild winter give it a tropical character. The year is conveniently divided into three distinct seasons viz. winter (November to February) summer (March to mid June) and rainy season (mid June to early October). The mean maximum temperature ranges from 23.75°C in January to 42.97° in May, and the mean minimum temperature is 28.11°C in May and 9.25°C in December. Relative humidity ranges from 63.77 per cent to 93.09 per cent for the whole year at 8AM. Total annual rainfall during the year 1970 was 759.80 mm of which 86.4 per cent occurred in the rainy season.

The soil is a deep alluvial deposit of the river Ganga; it is fertile. Ramam (1959) has given the details of physicochemical properties of the soil. It is pale brown in colour (10 YR 6/3; 6/2 moist) and is sandy loam or clayey in texture.

## Materials and Methods

### (a) *Charting of the vegetation*

The site was divided into three equal sub plots viz., I, II and III. Four permanent quadrats of 1 m × 1 m size were marked in each sub plot. The quadrat was divided into 10 × 10 sq. cm blocks by means of thread. The exact area occupied by individual plant was sketched on a scaled graph sheet showing exact position of the individuals. A sketch of the plots is given in Figure 1.

### (b) *Burning*

An area 2 m wide around each quadrat was left intact. The vegetation around the intact area was denuded by scraping for 1 m width. An iron rod was wrapped with cloth and soaked in kerosin oil. This was lit and with the help of its flame, quadrats with surrounding vegetation of 2 m were burnt in the I and II plots on 30th January, 1970. Fire was set at one or two places at the margin which spread over the ground surface since the vegetation was nearly dry and it consumed all the standing crop.

Unburnt plot III served as control. The 1st plot was again burnt on 30th of May in the same way. The ash remained mostly stuck on the tough ground due to protection offered by the surrounding vegetation and light shower within a few days of the burns.

## Results and Discussions

Each clump of *Dichanthium annulatum* and *Cynodon dactylon* is counted as an individual. Creeping plants like *Evolvulus numularis* are not dense enough, they are reduced by the dominance of *D. annulatum*, and can be easily plotted on the graph sheet. One separate creeper is considered as one plant. The basal cover and density of the different species are recorded for January, April and September of 1970 and January, 1971 in Tables I, II and III for the plots I, II and III respectively.

The results of this study indicate that a vigorous growth of leguminous plants succeeds fire. This rapid growth may be related to the fertilizing action of mineral nutrients released from the ash. *Cassia pumila, Cassia tora, Indigofera hirsuta, Rhynchosia minima* and *Zornia diphylla* all increase in the burnt plots. Similar increase in leguminous plants was also reported by Greene (1935) as a result of burning in the long leaf pine region, Blaisdell (1953), working on sagebrush land, found that herbs increased two or three times after fire.

The number of legumes increases still further after the second burning. It is apparent that while grass seeds and shoots burn easily fire destroys the hard seed coat of leguminous plants, making them more water permeable. *Rhynchosia minima* sprouts from the underground parts also. All the other species of the legumes appear through seed germination. Sampson (1944) reports that most dry seeds are killed by exposure to temperature of 250° to 300°F for five minutes or more. Seeds of certain plant species may however be stimulated to germination by short term exposure to heat.

It is also evident from the tables that the burning decreases the basal cover of the grass *D. annulatum*. The basal cover is highly decreased in the twice (winter and summer) burnt plot in comparison to the once (winter only) burnt and control plots.

TABLE I

*Basal cover and density of different species/m² in the first plot (burnt on 30th January, 1970 and 30th May, 1970)*

| Species | January 1970 | | April 1970 | | September 1970 | | January 1971 | |
|---|---|---|---|---|---|---|---|---|
| | Cover sq. cm/ m² | Density/ m² | Cover sq. cm/ m² | Density/ m² | Cover sq. cm/ m² | Density/ m² | Cover sq. cm/ m² | Density/ m² |
| *Dichanthium annulatum* | 555.251 | 48.0 | 291.198 | 43.0 | 389.381 | 36.75 | 422.655 | 36.0 |
| *Achyranthus aspera* | 0.356 | 0.25 | × | × | × | × | × | × |
| *Aeschynomene indica* | × | × | × | × | 1.42 | 0.50 | × | × |
| *Amania baccifera* | 0.285 | 0.25 | × | × | × | × | × | × |
| *Anagallis arvensis* | 11.613 | 11.25 | × | × | × | × | × | × |
| *Blumea lacera* | 1.567 | 1.25 | 1.42 | 0.50 | × | × | × | × |
| *Bonnaya brachiata* | 5.201 | 6.0 | × | × | 1.068 | 1.25 | × | × |
| *Cassia pumila* | 12.753 | 7.75 | 9.547 | 7.25 | 182.471 | 139.50 | 26.718 | 34.75 |
| *Cassia tora* | 2.066 | 1.50 | 2.85 | 2.25 | 11.257 | 4.25 | × | × |
| *Convolvulus pluricaulis* | 0.570 | 0.75 | 0.641 | 0.50 | × | × | 0.997 | 0.50 |
| *Corchorus acutangulus* | 6.768 | 5.25 | × | × | 25.65 | 22.0 | × | × |
| *Cynodon dactylon* | 88.848 | 42.50 | 117.705 | 70.25 | 12.82 | 5.75 | 7.053 | 5.0 |
| *Cyperus rotundus* | 0.783 | 0.75 | 3.420 | 2.25 | 2.565 | 1.50 | × | × |
| *Digitaria sanguinalis* | × | × | × | × | 1.852 | 1.50 | × | × |
| *Euphorbia hirta* | 3.847 | 2.75 | 2.85 | 3.50 | × | × | × | × |
| *Gnaphallium indicum* | × | × | × | × | 2.493 | 0.75 | × | × |
| *Indigofera hirsuta* | 0.72 | 0.50 | 2.208 | 1.75 | 6.41 | 1.50 | 2.493 | 1.0 |
| *Launaea asplenifolia* | × | × | × | × | 1.710 | 1.25 | × | × |
| *Phaseolus munga* | 0.356 | 0.25 | × | × | 1.068 | 0.25 | 0.712 | 0.25 |
| *Phyllanthus niruri* | 1.496 | 0.75 | × | × | 1.638 | 1.25 | 0.356 | 0.50 |
| *Polygonum plebejum* | 8.336 | 5.25 | × | × | × | × | × | × |
| *Rhynchosia minima* | 0.783 | 1.0 | 3.633 | 1.50 | 1.068 | 0.50 | 1.425 | 0.50 |
| *Setaria glauca* | 11.970 | 4.75 | × | × | 0.926 | 0.25 | × | × |
| *Trida procumbens* | 0.427 | 0.25 | 1.781 | 0.25 | 0.71 | 0.25 | × | × |
| *Vernonia cineria* | 1.923 | 0.50 | 2.778 | 1.0 | 3.135 | 1.0 | 1.068 | 0.50 |
| *Zornia diphylla* | 0.356 | 0.25 | × | × | 15.52 | 9.50 | 7.766 | 7.0 |

After the first burning in January basal cover in the first and the second plots is more decreased as compared with that of the control plot. The blackened surface of the burnt plots absorbs more heat during day time; this high temperature may be mainly responsible for the death of some tillers. It also inhibits the new growth of shoot from the rhizome and root stocks. In the control plot density of *D. annulatum* increases in the summer season. The single clump divides into separate distinct clumps with the death of some tillers due to high temperature and low moisture content of

the soil. Again the new growth of tillers fills up the space between the several patches and thus makes a single clump. This decreases the counting density of the grass.

TABLE II

*Basal cover and density of different species/m² in the second plot (burnt on 30th January, 1970)*

| Species | January 1970 | | April 1970 | | September 1970 | | January 1971 | |
|---|---|---|---|---|---|---|---|---|
| | Cover sq. cm/ $m^2$ | Density/ $m^2$ | Cover sq. cm/ $m^2$ | Density/ $m^2$ | Cover sq. cm/ $m^2$ | Density/ $m^2$ | Cover sq. cm/ $m^2$ | Density/ $m^2$ |
| *Dichanthium annulatum* | 446.238 | 37.25 | 331.618 | 32.50 | 532.023 | 32.25 | 494.403 | 30.75 |
| *Anagallis arvensis* | 2.066 | 2.0 | × | × | × | × | × | × |
| *Aneilima nudiflorum* | × | × | × | × | 19.593 | 15.0 | × | × |
| *Blumea lacera* | 5.70 | 1.50 | 8.906 | 2.75 | × | × | × | × |
| *Bonnaya brachiata* | 7.766 | 8.50 | × | × | × | × | × | × |
| *Cassia pumila* | × | × | 10.616 | 8.25 | 74.955 | 55.50 | 13.608 | 16.50 |
| *Cessia tora* | 0.498 | 1.25 | × | × | 0.855 | 0.25 | × | × |
| *Corchorus acutangulus* | 1.995 | 2.0 | × | × | 23.277 | 18.75 | × | × |
| *Cynodon dactylon* | 20.947 | 6.75 | 33.915 | 19.25 | 4.631 | 1.75 | 1.710 | 1.0 |
| *Cyperus rotundus* | 2.422 | 1.50 | 9.761 | 6.50 | 0.427 | 1.0 | × | × |
| *Digitaria sanguinalis* | 2.280 | 0.25 | 1.68 | 0.25 | 1.42 | 0.25 | × | × |
| *Eragrostis tenella* | 7.410 | 1.50 | × | × | 4.061 | 3.0 | 50.231 | 0.75 |
| *Euphorbia hirta* | 2.280 | 2.50 | 3.705 | 3.75 | × | × | 0.213 | 0.25 |
| *Evolvulus numularis* | 41.752 | 2.00 | 15.815 | 7.75 | 54.15 | 5.0 | 11.613 | 3.50 |
| *Indigofera hirsuta* | × | × | 3.206 | 2.75 | 11.328 | 2.50 | 4.631 | 2.00 |
| *Polygonum plebejum* | 1.42 | 1.25 | × | × | × | × | × | × |
| *Rhynchosia minima* | × | × | 5.415 | 3.0 | × | × | 0.356 | 0.25 |
| *Setaria glauca* | 2.066 | 0.50 | × | × | 6.483 | 4.25 | 1.353 | 0.75 |
| *Vernonia cineria* | × | × | 1.42 | 0.50 | × | × | × | × |
| *Zornia diphylla* | 0.855 | 0.50 | × | × | 12.468 | 6.50 | 3.776 | 3.50 |

Among other workers Kennan (1971) reports that annual burning reduces the basal cover of grasses at Matopos, Rhodesia. Lloyd (1972) studying the effects of fire on a Derbyshire grassland community, observed similar reductions in the cover values of *Festuca ovina, Helictotrichon pratense* and *Helianthemum chamaecistus,* after three months of burning.

*Cynodon dactylon* has maximum occurrence in summer season in the burnt and the control plots. In summr due to death of *D. annulatum* tillers bare area increases which gives space for the spread of *Cynodon dactylon.* In the growing season due to competition for light, moisture and space this plant is rapidly eliminated from the third plot. The burnt plots have still some of the plants of this species in the season.

TABLE III

*Basal cover and density of different species/m² in the third plot (unburnt control plot)*

| Species | January 1970 | | April 1970 | | September 1970 | | January 1971 | |
|---|---|---|---|---|---|---|---|---|
| | Cover sq. cm/ $m^2$ | Density/ $m^2$ | Cover sq. cm/ $m^2$ | Density/ $m^2$ | Cover sq. cm/ $m^2$ | Density/ $m^2$ | Cover sq. cm/ $m^2$ | Density/ $m^2$ |
| *Dichanthium annulatum* | 506.088 | 35.50 | 394.632 | 50.50 | 643.173 | 43.25 | 618.592 | 35.50 |
| *Aeschynomene indica* | × | × | × | × | 0.783 | 0.25 | × | × |
| *Aneilima nudiflorum* | × | × | × | × | 0.71 | 0.75 | × | × |
| *Bonnaya brachiata* | 7.623 | 5.0 | × | × | × | × | × | × |
| *Cassia pumila* | 3.206 | 3.50 | 1.638 | 1.0 | 0.356 | 0.25 | × | × |
| *Corchorus acutangulus* | 2.778 | 0.75 | 0.427 | 0.25 | 4.773 | 5.0 | × | × |
| *Cynodon dactylon* | 29.141 | 10.25 | 280.01 | 8.25 | 1.42 | 0.50 | 0.712 | 0.50 |
| *Cyperus rotundus* | 0.926 | 0.25 | 0.427 | 0.25 | 0.498 | 0.50 | × | × |
| *Desmodium triflorum* | 7.83 | 19.25 | 11.40 | 12.25 | 9.690 | 8.50 | 3.0993 | 4.25 |
| *Eragrostis tenella* | × | × | × | × | 2.778 | 1.25 | 1.068 | 0.50 |
| *Euphorbia hirta* | 2.493 | 1.0 | × | × | × | × | × | × |
| *Evolvulus numularis* | 65.479 | 12.0 | 28.215 | 9.50 | 16.672 | 5.0 | 1.718 | 1.25 |
| *Indigofera hirsuta* | 1.42 | 0.25 | × | × | 0.783 | 0.25 | × | × |
| *Phyllanthus niruri* | 5.058 | 4.50 | 7.552 | 4.75 | 6.341 | 4.0 | 1.068 | 1.50 |
| *Rhynchosia minima* | × | × | 0.356 | 0.25 | × | × | × | × |
| *Setaria glauca* | 0.855 | 0.25 | × | × | × | × | × | × |
| *Vernonia cineria* | × | × | 0.285 | 0.25 | × | × | × | × |
| *Zornia diphylla* | 3.633 | 1.75 | × | × | × | × | × | × |

The plant *Evolvulus numularis* is highly present in the second plot than in the third plot, since light, moisture and space competition is less in the vegetation of the second burnt plot.

The winter season brings about higher incidence of weeds in the grassland. The tables show that the commonest weed *Anagallis arvensis* and *Ploygonum plebejum* completely disappear after burning treatment. *Euphorbia hirta* is eliminated after the summer season in the burnt plots. Kucera and Koelling (1964) reported that in burnt plots of Missouri prairie non-grass species, particularly composites, became less prevalent as compared to unburnt plots on which the grasses showed a noticeable decline. Tester and Marshall (1962) showed that burning did not incur any noticeable shift in vegetation but could be used to reduce the density of undesirable species.

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