Research Article

A COMPARATIVE STUDY OF IMPACTS OF SOIL, WATER AND PHYTOHORMONES ON GROWTH OF RAPHANUS SATIVUS IN CERTAIN AREAS OF THE JAUNPUR CITY

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ABSTRACT

Raphanus sativus - an annual occasionally biennial, short stemmed herb with a rosette of lyrate is native of eastern India. A particular variety of Raphanus sativus named jaunpuri or newar grown in certain belt of Jaunpur city showed better growth in terms of length, girth and biomass at certain place and period of its growth cycle. However, this was not conspicuous in another cultivar of radish i.e. pusa chetki growing at the same site. Chemical analysis of water and soil was done by applying titrimetric methods. Hormonal analysis was done by using Mass spectrometer. It was found that the chemical properties of irrigated water, such as hardness, chloride content and electrical conductance, along with some physico-chemical properties of soil, such as nitrogen and organic carbon, supported the root growth of cv. newar 112.5% (length), 133.3% (girth) and 2077.5% (biomass) more than that of cv. pusa chetki. Among the three selected sites (Siddiquepur, Bhavrajipur and Mandi Nasheeb Khan), Bhavrajipur and Mandi Nasheeb Khan provided suitable environment for better growth of cv. newar.

KEYWORDS: Electrical conductance, Hardness, Newar, Pusa chetki, Phytohormones

INTRODUCTION

Word Raphan used from the Greek word The local name of radishes are on the basis of their linguistic considerations (1). Radishes can be categorized into four main types summer, fall, winter, and spring. The growth of radish root is supported by various soil types however; sandy loam soil is good for winter and spring crops. The seeds of the Raphanus sativus can be pressed to extract seed oil which is a potential source of biofuel. Radishes are suggested as alternative treatment for a variety of ailments including whooping cough, cancer, gastric discomfort, constipation, dyspepsia, liver and gallbladder problems, arthritis, gallstones, kidney stones and intestinal parasites. Radishes possess hydroxyl radical scavenging potency (2). Pharmacological basis for the gut stimulatory activity of the Raphanus sativus leaves show the presence of histaminergic component plus a weak spasmylytic factor that acts against constipation (3). Radish possesses nutraceutical properties and thus could be included in every day diet (4, 5). Besides, leaves and roots are having anticarcinogenic, antimicrobial and antiviral properties (6). In this present experiment it was planned to analyse the impact of soil, water and phytohormones viz., auxin and cytokinines on growth of Raphanus sativus cv. newar and pusa chetki in the hub of radish grower, Jaunpur district of India.

MATERIAL AND METHODS

Site selection

Three sites viz. Siddiquepur (S1), Bhavrajipur (S2) and Mandi Naseeb Khan (S3) were selected in periurban part of the Jaunpur city. Seeds of the two cultivars of Raphanus sativus such as newar/jaunpuri and pusa chetki were procured from the research station of Krishi Vigyan Kendra of N.D. University, Faizabad.

Experiment design

At all the three sites, experimental beds (size 1.5 m x 2.0 m) were prepared for sowing the two cultivars (newar and pusa chetki) of Raphanus sativus on
alternate bunds in October. Seedlings were thinned manually to maintain the interplant distance of 25 cm. The experimental beds were subjected to manure by cowdung and irrigated after every 5 days throughout the experiment. After 90 days growth, the plants were harvested and relevant observations i.e. length, girth and biomass of radish root were monitored. Fortnightly, top soil (0-25 cm depth) and irrigation water were sampled to analyze physico-chemical characteristics following standard protocols.

Physico-chemical analysis

Physico-chemical analysis of water was carried out with respect to electrical conductance, pH, hardness, chloride content, electrical conductance, soil organic carbon, phosphorus, potassium, nitrogen estimation. Electrical conductance and pH were analysed by digital pH meter and conductivity meter. Hormonal analysis was done by mass spectrometry.

RESULTS AND DISCUSSION

Changes in data of E.C., pH, hardness, and chloride content in water are shown in Table 1. The results revealed that average electrical conductance of the water was found maximum at Bhavrajipur site (S2) (4645.7 µS/m), followed by M. N. Khan site (S3) (3458.5 µS/m) and least at Siddiquepur site (S1) (1295.7 µS/m). Likewise, average hardness of water was maximum at site S2 (1271 mg/l), followed by site S3 (808.5 mg/l). The chloride content also followed the same trend. The significant changes observed in pH and EC of soil during the growth period at different sites are shown in Table 1.

Macro element analysis of water revealed maximum availability of organic carbon in soil at site S3 (0.75%), followed by site S2 (0.73%) and minimum at site S1 (0.57%) (Table 1). Same pattern was followed by nitrogen content. However, K content of the soil was maximally observed at site S1 (231 kg/ha), followed by site S2 (187 kg/ha) and the least at site S3 (176 kg/ha) (Table 1). Amount of phosphorus also followed this pattern of availability.

The growth pattern of both the varieties (newar as well as pusa chetki) at all the three sites was recorded. It revealed that percent increase in length at site S2 was observed maximum (112.5%), followed by S3 (83.3%), as compared to S1 site and in case of girth site S2 showed an increase of (133.3%) in girth, followed by site S3 (105.5%), as compared to S1. However, the biomass increase was observed maximum at site S3 (2077.45%), followed by site S2 (1701.8%), in comparison to site S1 (Fig. 1).

Estimation of phytohormones from root revealed that the amount of auxin in the root of radish of cv. newar at site S2 and S3 (1.5 and 1.4 µl/ml respectively) was higher than that of site S1 (0.9 µl/ml). Similarly, in the root of cv. pusa chetki same trend was observed (Table 2). Out of all the cytokinines estimated, the concentration of iP, tZR and Zeatin glucoside were remarkably high in cv. newar at site S2 and S3 and were observed least at S1site. The same trend was followed in case of cv. pusa chetki.

The results depicted that among the various physicochemical properties of water, EC of irrigated water appeared to be growth supportive at sites S2 and S3 as the girth of cv. newar was enhanced significantly (R² 0.92) with increasing EC values (Table 3).
Table 2: Seasonal pattern of Auxin and Cytokinin concentration in cv. newar and cv. pura chekhi of *Raphanus sativus*

<table>
<thead>
<tr>
<th>Sample name</th>
<th>Auxin (IAA (µl/ml))</th>
<th>tZR (µl/ml)</th>
<th>DZR (µl/ml)</th>
<th>Cytokinetines</th>
<th>iPA (µl/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>newar</td>
<td>Puran chekhi</td>
<td>newar</td>
<td>Pura chekhi</td>
<td>newar</td>
</tr>
<tr>
<td>S1</td>
<td>0.6</td>
<td>0.35</td>
<td>0.7</td>
<td>4.1</td>
<td>2.7</td>
</tr>
<tr>
<td>S2</td>
<td>1.0</td>
<td>0.9</td>
<td>1.1</td>
<td>9.0</td>
<td>6.7</td>
</tr>
<tr>
<td>S3</td>
<td>1.1</td>
<td>1.0</td>
<td>1.1</td>
<td>8.9</td>
<td>6.8</td>
</tr>
<tr>
<td>S4</td>
<td>0.9</td>
<td>0.75</td>
<td>0.9</td>
<td>2.5</td>
<td>1.0</td>
</tr>
<tr>
<td>S5</td>
<td>1.5</td>
<td>1.0</td>
<td>1.4</td>
<td>6.5</td>
<td>6.0</td>
</tr>
<tr>
<td>S6</td>
<td>1.4</td>
<td>1.1</td>
<td>1.3</td>
<td>6.4</td>
<td>6.2</td>
</tr>
<tr>
<td>S7</td>
<td>0.2</td>
<td>0.1</td>
<td>0.2</td>
<td>3.3</td>
<td>2.6</td>
</tr>
<tr>
<td>S8</td>
<td>0.5</td>
<td>0.4</td>
<td>0.6</td>
<td>5.5</td>
<td>5.6</td>
</tr>
<tr>
<td>S9</td>
<td>0.6</td>
<td>0.3</td>
<td>0.6</td>
<td>5.2</td>
<td>5.7</td>
</tr>
</tbody>
</table>

Table 3: $R^2$ (Correlation coefficient) values between soil or water properties and growth parameters

<table>
<thead>
<tr>
<th>Soil/water properties</th>
<th>cv. pura chekhi</th>
<th>cv. newar</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Length</td>
<td>Girth</td>
</tr>
<tr>
<td>pH (soil)</td>
<td>0.01</td>
<td>0.06</td>
</tr>
<tr>
<td>pH (water)</td>
<td>0.09</td>
<td>0.00</td>
</tr>
<tr>
<td>EC (soil)</td>
<td>0.32</td>
<td>0.79</td>
</tr>
<tr>
<td>EC (water)</td>
<td>0.53</td>
<td>0.53</td>
</tr>
<tr>
<td>Hardness (water)</td>
<td>0.53</td>
<td>0.52</td>
</tr>
<tr>
<td>Chloride (water)</td>
<td>0.54</td>
<td>0.53</td>
</tr>
<tr>
<td>Org. carbon</td>
<td>0.55</td>
<td>0.82</td>
</tr>
<tr>
<td>K</td>
<td>0.53</td>
<td>0.85</td>
</tr>
<tr>
<td>P</td>
<td>0.56</td>
<td>0.77</td>
</tr>
<tr>
<td>N</td>
<td>0.56</td>
<td>0.80</td>
</tr>
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</table>
However, lower EC value was found at site S1, where minimum growth was observed. In one of the experiments, it was observed that influx concentration of nutrients absorbed by *Raphanus sativus* L. was increased with an increase in soil EC from 1 to 13 dS/m (10). At S2 and S3 sites, hardness of irrigated water was also correlated with the growth of cv. newar as reflected by correlation coefficient ($R^2$ 0.92) (Table 3). Similarly chloride content of irrigated water has also been growth supportive as it showed positive correlation with length ($R^2$ 0.89) and with girth ($R^2$ 0.92) of cv. newar, while its concentration at site S1 was lower. Likewise, the soil highly enriched with organic carbon enhanced the growth of cv. newar significantly. In one of the findings it has been evaluated that with the supply of organic carbon, growth parameters like leaf area, root growth and total biomass increased significantly (11). However, soil K content was found to be negative correlated with radish growth ($R^2$ 0.87). It was observed that radish growth was more at sites S2 and S3 than that of S1 (Table 3). The shoot weight of soybeans was increased by increasing soil K (12). This showed that the soil K content at site S1 was supportive for shoot growth. Likewise, the phosphorus content was also inversely co-related with plant growth particularly girth of cv. newar ($R^2$ 0.91). It supports the findings, where grapevines supplied with phosphorus produced more shoot growth per unit than that under P undernourished (13). In contrast to K and P, nitrogen contents present at S2 and S3 sites showed positive co-relation with girth ($R^2$ 0.89) and biomass ($R^2$ 0.86) of cv. newar, exhibited conformity with the growth of Asparagus in response to soil nitrogen content (14).

The result findings of phytohormones depict that the growth of cv. newar was stimulated by the higher concentration of auxin at site S2 and S3, than that of site S1. The concentration of some of the cytokinens such as tZR, iP and Zeatin glucoside stimulated the growth of cv. newar at site S2 and S3 more than that of site S1. It was reported that the combination of both auxin and cytokinines were very effective for the growth of *Ficus Anastasia* (15).

**CONCLUSION**

On the basis of experimental results, it is concluded that physico-chemical properties of the soil and irrigated water along with phytohormones supported the growth of *Raphanus sativus* cv. newar and pusa chetti at sites S2 and S3 appreciably than that of site S1. Such a contrary behaviour of the three sites could be accounted for the qualitative and quantitative difference in various factors (physico-chemical properties of soil, water and plant hormones) along with difference in their genetic makeup which might have acerbated by interaction of environmental conditions.

**REFERENCES**