Review Paper on Thermal Image Technique for Germination Evaluation of Cotton and Soya bean Seeds

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Abstract – The progress occurred in the past few ten years in imaging, electronics and computer science, infrared thermal imaging technique has various smart applications in non-destructive testing . This offers a potential non-contact imaging modality for the determination of various quality based on the infrared radiation emitted from target foods. In this experiment thermographic method is proposed to know germination capacity of seeds. Invisible radiation patterns of objects are converted into visible images and these images are called thermograms or thermal images. Thermal imaging principally depends on converting the invisible infrared radiation emitted by the objects into visible two-dimensional temperature data without making a direct contact with the examined objects. The evaluation of seed and is very important research problem and a practical problem. The set of measurements and the methodology applied made it possible to determine the average temperature of the seeds and their parts and to identify specific fragments of the image due to simultaneous registration in the visible and IR range. Seeds based on the infrared thermography technique. This article reviewed that the thermal imaging systems in seed applications including estimation of seed viability, evaluation of fungal growth ,insect infections, detection of seed damage and impurities, seed classification and variety identification.

Key Words: Thermal Infrared Imaging, Seed Germination; Image Processing, Thermography, Seed, Grain, Quality, Temperature

1.INTRODUCTION

Germination of seed is one of the very important stage of the plant life. Different methods have been applied to overcome the seed dormancy such as regulatory hormones[1], salinity, temperature, and humidity[2], light andhormones , salinity, temperature, and humidity, light and seed scarification,[3] seed stratification and fertilizers [4,5]. This work focuses on the monitoring of an irrigated seeds. The farming segment is the principal patron of the Indian economy. Conventional methods for ascertaining agrarian parameters are solid. The development of infrared thermography based tools for the analysis of water distribution efficiency in irrigated agricultural fields, aiming at optimizing the use of water in agricultural systems. These tools use non-invasive and non-destructive technology. The first infrared camera was developed by Tihanyi in 1929 and was applied for anti-aircraft defense by the British army. The first uses of Infrared thermography (IRT) in trees was the assessment by infrared imaging of the crown condition, using monochrome and false colour films.[6] The potential use of this technique in the agricultural field includes irrigation scheduling, soil properties mapping, plant disease detection, crop yield estimation, evaluating the maturity of the crop, etc. This paper briefly reviews some of the works on thermal imaging.

1.1 Present scenario

The high cost of GM seed is a key factor in the high demand for and growth of chemical seed treatments. Seed treatment not only protects the seeds from seed and soil borne diseases but also gives protection to the emerged seedlings from sucking insect pests affecting crop emergence and its early growth.

2.MATERIALS AND METHODS

The review was done English. The keywords were used : Infrared thermography, inspection techniques, non-destructive, non-invasive, sustainable, monitoring, classification, deterioration detection, relevance, benefits, risks, management, tree, tree heritage, and timber. The keywords were combined with each other[7].Thermal Sensors ,An infrared thermal imaging system consist of a thermal camera equipped with infrared detectors, a signal processing unit and an image acquisition system. Thermal imaging systems are evaluated on their thermal sensi-tivity, scan speed, image resolution, and intensity resolution [8]. Table 1 describes the specifications and pri-mary purpose of operational thermal sensors (still operating) that can be used in various studies that will be dis-cussed in this paper[9].

Table -1: Thermal infrared sensors.

Name of the sensor	Wavelength (μm)	Waveband	Spatial resolution (m)	Primary purpose
AATSR/ENVISAT	10.8	Band 6	1000	Sea surface temperature
	12	Band 7	1000	
	7.34	Band 10	2000	Lower-level water vapor, winds and SO2
	8.5	Band 11	2000	Total water for stability, cloud phase, dust, SO2, rainfall
	9.61	Band 12	2000	Total ozone, turbulence, winds
ABI/GOES-R	10.35	Band 13	2000	Surface and cloud
	11.2	Band 14	2000	Imagery, SST, clouds, rainfall
	12.3	Band 15	2000	Total water, ash, SST
	13.3	Band 16	2000	Air temperature, cloud heights and amounts Aster
	8.12-8.47	Band10	90	Surface temperature
	8.47-8.82	Band11	90	Surface temperature
Aster	8.92-9.27	Band12	90	Surface temperature
	10.25-10.95	Band13	90	Surface temperature
	10.95-11.65	Band14	90	Surface temperature
	3.50-3.93	Band3	4400 and 1100 in USA	Night cloud mapping, sea surface temperature
AVHRR	10.30-11.31	Band4	4401 and 1100 in USA	Night cloud mapping, sea surface temperature
	11.50 - 12.50	Band5	4401 and 1100 in USA	Sea surface temperature
	3.0-5.4	Band 9	5	Oil spill detection, mapping and detection of fire and geologic areas
Landsat7 ETM+	10.40-12.50	Band 6	60	Thermal mapping and estimated soil moisture
MERSI/FY-3	11.25	Band 5	250	Land, cloud and aerosols properties
	3.92-3.98	Band 22	1000	Cloud temperature, surface temperature

3. Principles of IRT

Infrared thermography (IRT) is a non-contact, non-destructive, and non-invasive technique that allows the detection of radiated heat energy from objects and bodies in the infrared range of the electromagnetic spectrum (wavelength range between 0.8–14 μm [10]). The conversion of infrared energy into visible imaging is possible through instruments that produce false-colour images, such as an infrared camera [11]. The principle underlying IRT is a method or equipment, which detects IR energy emitted from a surface, converts it to temperature, and displays the image of temperature field [10,12-17]. The fundamental concept behind it is that all bodies (alive and non-alive) have temperatures above absolute zero degrees (0 K) and emit infrared radiation that is captured by equipment capable of transforming that energy into pictures. The internal structure of the body shows different thermal behaviour depending on the health conditions of its parts. The differences in thermal behaviour result in differences in the colour pattern of the body surface image.[7] Thermal imaging framework includes thermal camera furnished with a picture securing framework, a signal processing unit, and infrared indicators. The infrared radiation discharged by the object is absorbed by the locator and is changed over into electrical signal which is sent to signal processing framework where the data will be changed into thermal image. Thermal imaging gadgets are of two kinds to be specific cooled and uncooled. An infrared imaging framework will be viewed as in light of the picture resolution, examine speed and thermal affectability.

4 THERMAL IMAGING APPLICATION

There are various applications of thermal imaging in agriculture start from soil water stress estimation, crop water stress estimation, water system planning, plant disease identification, farming plastic waste location, etc. Figure1 describes the taxonomy of thermal imaging for agricultural applications. The purpose of this paper is to review and how the thermal imaging is useful in agricultural filed. [19]

4.1 Thermal imaging application in agricultural sector

Thermal imaging in the agricultural application we have mainly classified into seven sections as shown in the taxonomy (fig1)[18] as irrigation scheduling, crop maturity and yield mapping, soil properties mapping, field tile mapping, agricultural plastic waste estimation, crop residue cover, and tillage mapping and plant disease detection.

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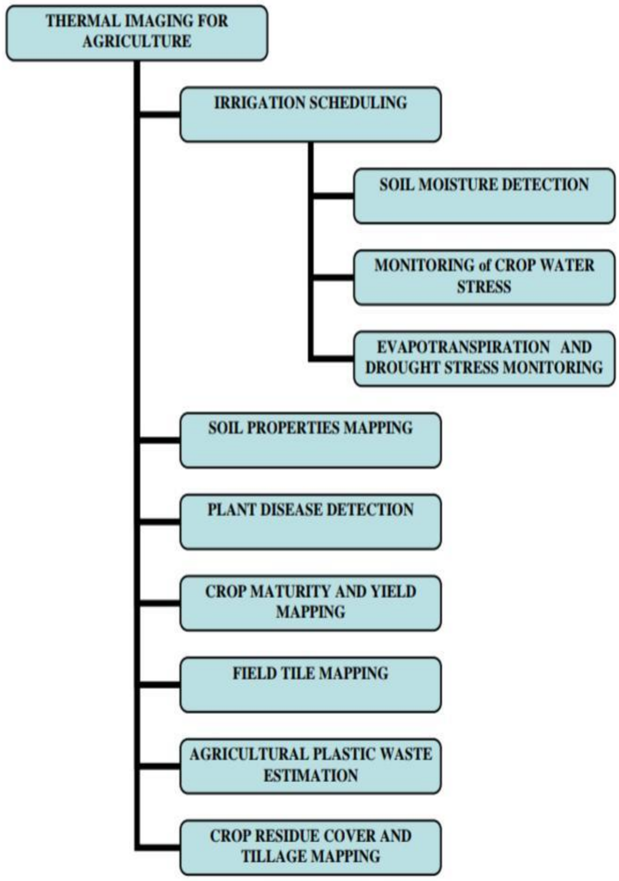

Fig:4.1- Taxonomy of thermal imaging for agricultural applications

Thermal imaging process plays an important role in many agricultural applications [21]–[23]. But still need some research [24]–[26]; which seems that will going to great help in near future. Ex. Ice formation in plant tissues detection, which is challenging, there are many methods available but that were difficult and time-consuming. For the study of freezing behavior and ice-nucleation of potatoes and cauliflower [26], [27] thermal cameras were used. It gave information about ice nucleates and how it spreads into potatoes and cauliflower. Infrared video thermography was used [28] to study the freezing of barley which showed that initial spread of freezing was not problematic but the damage was caused by the second freezing event, which was initiated by the first event.

5. CONCLUSION

This survey has briefly analyzed the current situation of the major application of thermal remote sensing. Thermal imaging systems have been developing quick and assuming an imperative part in different fields of agribusiness., But it has a few downsides when compared with other imaging techniques; good-quality thermal imaging is costly and to build up an all-inclusive procedure for agrarian applications may not be conceivable since thermal conductivity of crops/fruits shift with change in climatic conditions. Thermal imaging has been growing fast and playing an important role in various fields. This technique gains the popularity in agriculture due to its higher temporal and spatial resolutions images. However, intensive researches need to be conducted for its potential application in other various processes of agriculture (e.g. Yield forecasting) that are not yet investigated.

REFERENCES

[1] Sozi G, Chiesa AO (1995) Improvement of caper (Capparisspinosa L.) seed germination by breaking seed coat-induced dormancy. Scientica Horticulture 62(4): 255-261.
[2] Bradbeer JW (1998) Seed Dormancy and Germination. Chapman and Hall, New York, USA, pp. 38-54.
[3] Lindig CR, Lara-Cabrera S (2004) Effect of scarification and growing media on seed germination of Crotalaria pumila (Ort.). Seed Science and Technology 32(1): 231-234.
[4] Ramteke AA, Shirgave PD (2012) Study the effect of common fertilizers on plant growth parameters of some vegetable plants. Journal of Natural Product and Plant Resources 2(2): 328-333.
[5] Ramteke AA, Narwade ML, Gurav AB, Chavan SP, Wandre AG (2013) Study of germination effect of fertilizers like urea NPK and biozyme on some vegetable plants. Der Chemica Sinica 4(3)
[6] Catena, A. Thermography Reveals Hidden Tree Decay. Arboric. J. 2003
[7] Daniele Vidal and Rui Pitarma, Infrared Thermography Applied to Tree Health Assessment: A Review, Published: 15 July 2019, Agriculture 2019, 9, 156; doi:10.3390/agriculture9070156
[8] Vadivambal, R. and Jayas, D.S. (2011) Applications of Thermal Imaging in Agriculture and Food Industry—A Review. Food Bioprocess Technology, 4, 186-199. http://dx.doi.org/10.1007/s11947-010-0333-5
[9] Khaled Abubakr Ali Abutaleb ,Faruk Ahmed, APPLICATION OF THERMAL IMAGING IN AGRICULTURE- A REVIEW Article in Advances in Remote Sensing · September 2014 DOI: 10.4236/ars.2014.33011
[10] Usamentiaga, R.; Venegas, P.; Guerediaga, J.; Vega, L.; Molleda, J.; Bulnes, F. Infrared Thermography for Temperature Measurement and Non-Destructive Testing. Sensors 2014, 14, 12305–12348.
[11] Maldague, X.P.V.; Streckert, H.H.; Trimm, M.W. Introduction to Infrared and Thermal Testing. In Infrared and Thermal Testing; Maldague, X.P.V., Moore, P.O., Eds.; Nondestructive Testing Handbook; American Society for Nondestructive Testing: Columbus, OH, USA, 2001; ISBN 978-1-57117-044-6.
[12] Snell, J.R., Jr. Thermal Infrared Testing. In Handbook of Nondestructive Evaluation; Hellier, C., Ed.; McGraw-Hill: New York, NY, USA, 2003; ISBN 978-0-07-139947-0.
[13] Meola, C. (Ed.) Carosena Origin and Theory of Infrared Thermography. In Infrared Thermography Recent Advances and Future Trends; Bentham Science Publishers: New York, NY, USA, 2012; pp. 3–28. ISBN 978-1-60805-143-4.
[14] Ibarra-Castanedo, C.; Maldague, X.P.V. Infrared Thermography. In Handbook of Technical Diagnostics; Czichos, H., Ed.; Springer: Berlin/Heidelberg, Germany, 2013; pp. 175–220. ISBN 978-3-642-25849-7.
[15] Holst, G.C. Common Sense Approach to Thermal Imaging; JCD Pub.; Co-Published by SPIE Optical Engineering Press: Winter Park, FL, USA; Bellingham, WA, USA, 2000; ISBN 978-0-9640000-7-0.
[16] Pitarma, R.; Crisóstomo, J.; Jorge, L. Analysis of Materials Emissivity Based on Image Software. In New Advances in Information Systems and Technologies; Rocha, Á., Correia, A.M., Adeli, H., Reis, L.P., Mendonça Teixeira, M., Eds.; Springer International Publishing: Cham, Switzerland, 2016; Volume 444, pp. 749–757. ISBN 978-3-319-31231-6.
[17] Crisóstomo, J.; Pitarma, R. The Importance of Emissivity on Monitoring and Conservation of Wooden Structures Using Infrared Thermography. In Advances in Structural Health Monitoring; Hassan, M., Ed.; IntechOpen: London, UK, 2019.
[18] Aryalekshmi B N, R C Biradar, Mohammed Ahamed J , Thermal Imaging Techniques in Agricultural Applications, Volume-8 Issue-12, October 2019
[19] K. Tempfli et al., —Principles of Remote Remote Sensing,|| p. 591, 2009.
[20] M. Bisquert, J. M. Sánchez, R. López-Urrea, and V. Caselles, —Estimating high resolution evapotranspiration from disaggregated thermal images,|| Remote Sens. Environ., vol. 187, pp. 423–433, Dec. 2016.
[21] R. A. ElGamal, S. S. Kishk, and G. M. ElMasry, —Validation of CFD models for the deep-bed drying of rice using thermal imaging,|| Biosyst. Eng., vol. 161, pp. 135–144, Sep. 2017.
[22] S. M. Z. Younis and J. Iqbal, —Estimation of soil moisture using multispectral and FTIR techniques,|| Egypt. J. Remote Sens. Sp. Sci., vol. 18, no. 2, pp. 151–161, Dec. 2015.
[23] A. Nishar, S. Richards, D. Breen, J. Robertson, and B. Breen,—Thermal infrared imaging of geothermal environments and by an unmanned aerial vehicle (UAV): A case study of the Wairakei – Tauhara geothermal field, Taupo, New Zealand,|| Renew. Energy, vol. 86, pp. 1256–1264, Feb. 2016.
[24] L. Jiao, D. Dong, H. Feng, X. Zhao, and L. Chen, —Monitoring spray drift in aerial spray application based on infrared thermal imaging technology,|| Comput. Electron. Agric., vol. 121, pp. 135–140, Feb. 2016.
[25] M. . Fuller and M. Wisniewski, —The use of infrared thermal imaging in the study of ice nucleation and freezing of plants,|| J. Therm. Biol., vol. 23, no. 2, pp. 81–89, Apr. 1998.
[26] L. Cuibus, M. Castro-Giráldez, P. J. Fito, and A. Fabbri, —Application of infrared thermography and dielectric

spectroscopy for controlling freezing process of raw potato,‖ Innov. Food Sci. Emerg. Technol., vol. 24, Aug. 2014.
[27] R. S. Pearce and M. P. Fuller, ―Freezing of barley studied by infrared video thermography.,‖ Plant Physiol., vol. 125, no. 1, pp. 227–40, Jan. 2001.